Rat River Wetland Development Task Force Report

September 1988

Manitoba

RAT RIVER

WETLAND DEVELOPMENT

TASK FORCE REPORT

SEPTEMBER 1988

EXECUTIVE SUMMARY

The area of the Rat River in Township 3 Range 6 and 7E has a long history of spring flooding. Farmers have attempted to deal with this problem for some time as water control would provide additional arable acres as well as provide them the ability to plan their farming operation based on known spring water levels. In the late 1970's and early 1980's investigations into a flood control project to improve agricultural potential in the area were found to be too costly for agricultural benefits alone.

The designation of the Rat River Wildlife Management Area in 1984 sparked renewed interest in the area. A request was submitted by the Provincial Wildlife Branch to Ducks Unlimited to evaluate the potential of the area for development of wetland habitat. Preliminary studies conducted by Ducks Unlimited determined the area had good potential for a wetland development project.

In April of 1985 the L.G.D. of Stuartburn passed a resolution supporting the wetland development proposal. A proviso in the resolution was that Water Resources Branch construct and maintain a dyke/containment structure in Township 3 Range 7E to prevent flooding of farmland adjacent to the Rat River.

Based on the positive response of area landowners and the L.G.D. the Rat River Wetland Development Task Force was established by the Province in 1986. The mandate of the task force was to develop a benefit\cost analysis for the wetland development project. Benefits to agriculture, waterfowl, fisheries, wild fur and recreational use were estimated based on feasibility studies completed by Ducks Unlimited for a 5000 ha, seven cell wetland complex with a flood storage reservoir.

Two development options are considered viable. The second option provides approximately 10% more area and requires private land acquisition and relocation of a crown land lease, both of which are considered reasonable.

Under option 1 costs of the project were estimated to be $6,316,400 up to year 30 and $7,554,400 over 50 years. Benefits to all resources are estimated to be $6,268,500 over 30 years with a benefit\cost of 0.99 and $8,999,000 over 50 years with a benefit\cost of 1.19. Option 2 would have a benefit/cost of 1.06 over 30 years and 1.28 for 50 years.

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INTRODUCTION

The Rat River Wetland area south of the Rat River in Township 3 Ranges 6 and 7E has historically been subject to flooding, which reduced the agricultural potential of the area. In the late 1970's and early 1980's investigations into a flood control project to improve agricultural potential in the area were found to be too costly for agricultural benefits alone.

The designation of the Rat River Wildlife Management Area in 1984 renewed interest in the possibility of a water control project that could benefit both agriculture and wildlife.

To effectively assess the impact of a wetland project a Task Force was established in August of 1986. Participants in the task force were the Water Resources, Fisheries and Wildlife Branches of the Manitoba Department of Natural Resources, the Manitoba Department of Agriculture, Manitoba Department of Municipal Affairs and Ducks Unlimited. The role of the task force was to determine benefits and disbenefits of a water control project. For the purpose of benefit cost analysis the benefits are calculated over a 30 year and a 50 year period.

TASK FORCE MEMBERS

R. J. Robertson (Chairman) ..... Manitoba Natural Resources
Wildlife

D. Flavell.....Ducks Unlimited

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H. Schellenberg.....Manitoba Department of
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J. Smithson.....Manitoba Natural Resources
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* D. Sexton left Task Force (1986)

1.0 Background

The area of the Rat River in Township 3 Range 6 and 7E (Figure 1) has a long history of spring flooding. This problem occurs in approximately nine out of every 10 years and has reduced the agricultural potential of the area. Farmers have attempted to deal with this problem for some time as water control would provide additional arable acres as well as provide them the ability to conduct their farming operation based on known spring water levels.

In 1979 a group of area farmers established the Stuartburn Piney Agricultural Development Association (SPADA). Supported by the Local Government District of Stuartburn the Association presented a brief to the Province requesting a flood control project be initiated in the area. SPADA indicated that approximately 1500 acres of cropland is affected annually by spring flooding. Approximately 300 acres could not be seeded and 1200 acres experienced seeding delays. The average annual benefit that could be realized through flood control was approximately $76,000.00.

A 1980 study by the Provincial Water Resources Branch found that cost/benefits to agriculture did not justify the expense of a flood control project as requested by SPADA. In 1982 Water Resources reviewed the previous study and confirmed earlier results that a water control project could not be justified by agricultural benefits alone.

The designation of the Rat River Wildlife Management Area in 1984 sparked renewed interest in the area. A request was submitted by the Provincial Wildlife Branch to Ducks Unlimited to evaluate the potential of the area for development of wetland habitat. Preliminary studies conducted by Ducks Unlimited determined the area had good potential for a wetland development project. These findings coupled with renewed

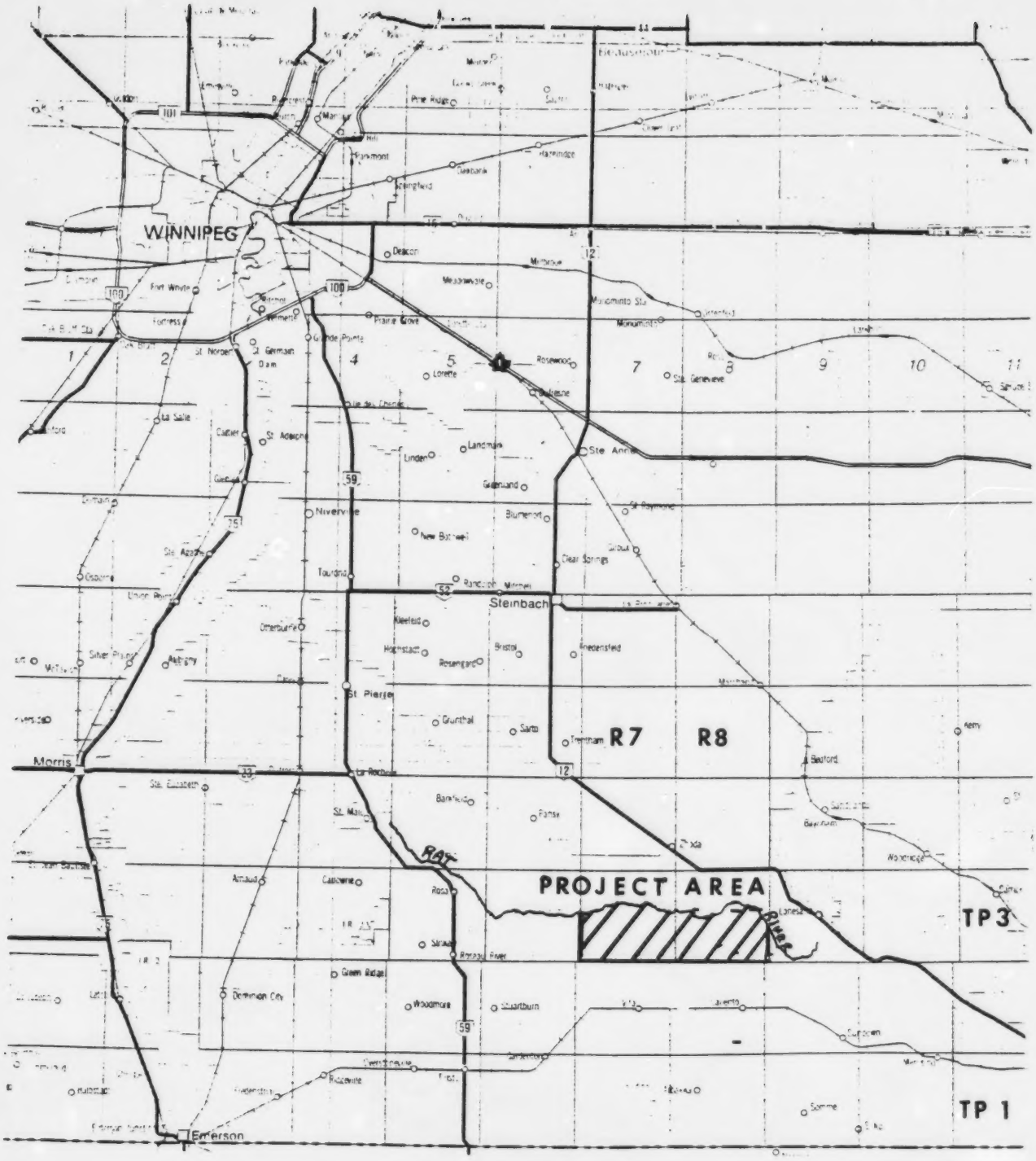

Figure 1. Rat River Wetland Development project area.

interest on behalf of SPADA and the L.G.D. of Stuartburn resulted in a request by local interest groups for the Province to once again look into the feasibility of a water control project that would benefit both agriculture and wildlife.

In February of 1985 a meeting was held with the L.G.D.of Stuartburn, SPADA representatives, Ducks Unlimited, Water Resources and the Wildlife Branch to assess the feasibility of a project. Ducks Unlimited outlined a wetland development proposal that would encompass a portion of the Rat River Wildlife Management Area as well as several thousand hectares of L.G.D. land situated south of the W.M.A. For the project to be feasible both the L.G.D. and W.M.A. lands would be required.

In April of 1985 the L.G.D. of Stuartburn passed a resolution supporting the wetland development proposal and indicated their willingness to enter into a lease agreement with Ducks Unlimited on lands required for the project. The L.G.D. was also prepared to negotiate a land exchange with the Province to help offset construction costs.

A proviso in the resolution was that Water Resources Branch construct and maintain a dyke/containment structure in Township 3 Range 7E to prevent flooding of farmland adjacent to the Rat River.

This local support combined with the initial feasibility of the project led to the development of the Rat River Wetland Development Task Force by the Department of Natural Resources. The multi-disciplinary task force was formulated and formalized by August of 1986. The mandate of the task force was to complete a benefit/cost analysis for the project.

1.1 Action required

The Task Force had four primary responsibilities in completing the benefit/cost analysis for the project.

These were:

1) For each development option determine the agriculture, wildlife, fisheries and other benefits and disbenefits as well as the cost of works required.
2) Undertake a benefit cost and net benefits analysis of water management options.
3) Obtain input and review from local governments and local interest groups (SPADA) at all stages of the study.
4) Prepare a report summarizing the results of the study by March, 1987.

2.0 Development Proposal

2.1 Development Objectives

The Rat River Swamp proposal has three primary objectives, namely to 1) limit flooding to Joubert Creek thereby increasing agriculture potential of the area; 2) develop a viable waterfowl project; and 3) not increase flooding on the Rat River downstream of the project.

2.2 Limit flooding to Joubert Creek

Flood control is required to prevent inundation of agricultural lands between the Rat River and Joubert Creek. The development objective is to limit uncontrolled overflow to Joubert Creek to minimal values in most years.

Due to the droughtiness of the agricultural soils, it is considered necessary to maintain a small flow to Joubert Creek to maintain the water table. This flow should occur in spring and continue through the growing season(mid-August). For the purpose of the study, this flow was taken as .75m3/s (26 cfs). This flow would be available in the spring in only about 7 years out of 10, but in all except extreme dry years during summer.

A concern was expressed that somewhat larger flows during spring runoff might be desirable if the historic flows from the Rat are important to the fishery in Joubert Creek. This possible requirement was not incorporated in the study and will require further examination. Larger spring flows would be an asset to project operation in average and above average runoff years, but would be difficult to provide in low runoff years.

2.3 Develop a viable waterfowl project

A viable waterfowl project requires the provision of impoundments with the capability of maintaining relatively stable spring water levels, with substantial areas having water depths in the 0.5 m to 1 m range throughout the year. The works should have the ability to remove excessive spring runoff such that levels return to the operating range by late spring, and the ability to replace excessive evaporation and seepage losses. As this project has substantial muskrat benefits, the latter is particularly important for muskrat over wintering.

The works should also have the ability to hold water levels above the normal operating levels from time to time, and to periodically drain the marsh for a season or two every decade for control and re-establishment of marsh vegetation.

2.4 Avoid increased flooding downstream of the Rat River

Historically the mean flow in the Rat downstream of the project during April and May was about 50% of the peak (maximum mean daily) flow during that period. Increasing the mean flow to 75% of the peak in above average runoff years would allow objectives 1 and 2 to be met. It is judged that, although there may be some minor increase in bank erosion due to the increased duration of high flows, this operation would not create flooding problems on lands adjacent to the Rat, and is therefore acceptable.

3.0 Proposed Works

3.1 Option 1

To create the water depths required for the waterfowl project, it would be necessary to impound water above naturally occurring levels. To prevent overflow to Joubert Creek while limiting flows downstream in the Rat, it would also be necessary to impound water in the spring, then gradually release it during the summer and fall. The project, then, would consist of a system of dykes to create 7 marsh cells and a storage reservoir (Appendix I). The total impounded area at FSL would be 5,266 ha. The 7 cells would provide the required capability for independent water level control and management.

In addition to the temporary spring storage provided in the cells, the reservoir would provide an impoundment which is solely dedicated to flood storage. The reservoir would have limited wildlife benefits in shallow zones on an intermittent basis.

All cells would have inlet and outlet control structures for water supply and water level control and management capability. Cells 1 to 7 would typically be supplied via the reservoir and exterior supply channels. All outlets would drain directly to the river. There would also be a large control on the reservoir as its outlet to the Rat River.

3.2 Option 2

A second development option is available which would increase the project area by approximately 268 ha and add considerable benefits(Appendix I A). To proceed with this option approximately 220 ha of private land would have to be acquired and a crown land lease would have to be terminated. Operation and design of the project would change very little however less dyking would be

required resulting in decreased construction costs.

3.3 Project Operation

3.3.1 Normal operation

In spring prior to runoff, the cells would typically be at a level 0.5 m below their respective FSL's, and the reservoir would be empty. In years of adequate to heavy runoff, all basins would rise to near or above FSL. The cells would be lowered to summer operating levels (FSL-0.15). and the reservoir to FSL, by June 1. After June 1, the reservoir would be gradually lowered to empty by late fall. The cells would also be allowed to slowly drop, but only to a level 0.5 m below FSL by freeze-up.

In years of heavy runoff, high flows would be maintained in the Rat River from the beginning of runoff through to the end of May. Control structures will be designed such that mean April and May flows will not exceed 75% of pre-project peaks. Uncontrolled overflows to Joubert Creek would still occur about once every 10 years.

In years of low runoff, the reservoir would not be filled. If water was lacking to fill the cells to FSL, they would be filled only to summer operating levels. Further shortfalls would result in individual cells not being filled. Riparian(stream) flows of 0.85 m3/s (30 cfs) would be maintained in the Rat River downstream of the project. This flow would have priority over the needs of the cells.

The selected flow of the Rat River is equal to the 90% mean spring flow, ie. the flow which is exceeded about nine years in ten. Post-project, this flow would be exceeded only seven years in ten, ie. there would be two additional years at this low flow. Some concern has been expressed by Fisheries Branch about this change.

Summer flow rates will typically be increased over pre-project values.

3.3.2 Drawdowns

Each cell would be drained (drawdown) about once every eight to ten years for vegetative regeneration. Drawdowns would occur in the fall and be maintained through the following year. In the next year each basin would be partially refilled, and normal operation would resume the following spring. As there are seven cells, there would be one cell in each stage of drawdown essentially every year.

4.0 Geotechnical Concerns

Due to the sandy nature of the soils in the region, there is concern as to the ability of the dyked impoundments to maintain the required water levels during the summer lower flow periods and in low runoff years. A preliminary soils field program and geotechnical analysis done in the summer of 1986 yielded cautiously positive results.

More extensive geotechnical investigation confirmed the original impression of surface soils consisting of tills overlain by sands and/or peats. It did, however, identify extensive areas of deep peats (up to 2m), and more areas of coarse sand or gravel lenses. The latter would require key trenching of less permeable material to reduce seepage losses.

Dyke designs, which were prepared to limit seepage, especially at the reservoir and downstream limits of the project, effectively control the volume of seepage so that it does not place any limits on the project. The dykes were also designed to resist wind and wave action. Various designs were recommended, depending on soil conditions (eg. peat depth), dyke height, and exposure to wave action. Construction methods recommended were local borrow for shallower peat depths and drier conditions, and end haul from borrow pits

for deeper peat areas. It should be possible to use crawler tractors and scrapers or motor scrapers for most of the work. Some ripping may be required where borrows are in till.

5.0 Benefits and Costs (Option 1)

Benefits and costs described in this section are based on the first development option. The benefits and costs of option 2 are provided in section 10 of the report.

5.1 Waterfowl

5.1.1 Potential Waterfowl Production

With the increase in water permanency as a result of the impoundments and the improvement in vegetation interspersion through water level management, waterfowl production should increase dramatically. Post development waterfowl production estimates are based upon extrapolations from detailed brood surveys of DU project areas considered to have comparable habitat conditions and located in the same or similar biomes. From estimates of average summer water levels post development, about 3,272 ha of brood habitat would be created. The reservoir would hold limited water through the summer period. It is considered habitat for breeding pairs annually, and would occasionally provide brood habitat. Waterfowl production for the area managed is estimated to be about 8,650 birds per year following development.

5.1.2 Waterfowl Staging

Following development, the large area of wetland, good quality habitat and protection afforded by the large cell areas will undoubtedly attract many more migrant waterfowl; both ducks and geese. Presently the few open ponds hold ducks and occasionally geese in autumn. Estimating the post development staging population is difficult. Data are available from two comparable areas in similar habitat in Minnesota; the Agassiz National Wildlife Refuge and Roseau River Wildlife Management Area provide a source for extrapolation. Waterfowl staging is estimated at 450,000 bird-days annually, following completion of the Rat River project.

5.1.3 Waterfowl Cost Benefits

The projected waterfowl benefits of the project are based on Ducks Unlimited cost/benefit criteria. Assuming a value to waterfowl of $10 per duck produced and $0.04 per bird day of staging use, the value can be calculated as follows over a 30 and 50 year project :

Benefit		Value
Production: 8,650 birds/yr x $10		$86,500/yr
Staging: 453,030 bird-days x $0.04		$18,120/yr
Total Waterfowl Value	@ 30 years	$3,138,600
	@ 50 years	$5,231,000

5.1.4 Waterfowl Disbenefits

The primary disbenefit relates to increased waterfowl depredation. Flood control will provide more arable land suitable for cereal crop production.The level of agricultural crop damage which has occurred in the area has been low. Between 1982 and 1985 there were only two applications for waterfowl compensation payments, both occurring in 1985 for a total cost of $8,300.00. The number of waterfowl depredation complaints registered from the area has also been low. In 1985 eleven complaints were actioned by Natural Resources staff and in 1986 and 1987 only two and three complaints were actioned, respectively. The increase in waterfowl production and use will result in increased depredation.

The recommended action is to develop a system of crown land lure crops in the area (approximately 46 ha annually) combined with an annual crop damage prevention program. Annual cost of lure crop production would be approximately $7000.00. The initial cost of equipment to operate a protection program would be $30,000.00 with an annual operating cost of $10.0 to $15.0(Appendix I B). The total cost of lure crops and the protection program discounted at 5% would be $263,500.00 over 30 years and $349,000.00 over 50 years.

A second option is to construct a feeding station within the project area combined with an annual damage prevention program. With an initial development cost of approximately $20,000.00 and an annual operating cost of $12,000.00 for the feeding station the cost would be approximately $182,200.00 over 30 years and $216,800.00 over 50 years. The option of a feeding station is considered to be least desirable.

5.2 Fisheries Benefits

Fisheries benefits and disbenefits are analyzed by separating the Rat River into five sections. These are:

1. Headwater to project.
2. Project area.
3. River channel to St. Malo Reservoir.
4. St. Malo Reservoir.
5. River channel to Red River.

Although information is limited, the development proposal as outlined by has both positive and potentially negative effects on the fishery (Appendix II). The single positive factor is through the production of walleye fry (Stizostedion v. vitreum) to the fingerling stage in the cells created by this wetland project. These fingerling would be released to other water bodies in need of stocking. The value of fingerlings as outlined in Appendix II is calculated to be $21,800.00/year. At a 5% discount rate the net present value of the benefits would be $418,000.00 over 30 years and $595,000 over 50 years.

Other than the value of the project as a site to rear fingerlings there were no other apparent fisheries benefits in the remaining four sections of the Rat River.

5.2.1 Potential Fisheries Disbenefits

There are concerns relating to changes in water flow in the area between the DU project and the Red River. The volume of run-off downstream of the development would be 50% greater post project than it is currently. The negative impact from increased flow would be in altering the natural equilibrium of the river causing an increase in bank and channel erosion. Increased flows could also disrupt spawning of sport fish through an increase in turbidity and siltation of sediment on spawning areas.

The St. Malo Reservoir would also be impacted through increased run-off. The negative impact on the reservoir could be in the form of increased nutrient loading from eroded channels downstream of the project area resulting in reduced water quality. An inadequate flushing rate in the reservoir to remove nutrients and sediment could compound water quality problems and reduce available fish habitat.

The negative impact on the Rat River channel from the St. Malo Reservoir to the Red River is primarily in the area of sport fish production. A reduction in area and quality of spawning habitat (through channel erosion and increased sediment deposits) below the Reservoir could impact negatively on the Red River sport fishery.

A monetary value of the fisheries disbenefits is not available because of the current lack of information on the Rat River fishery. The disbenefits outlined in this section are speculative and additional information on soils, hydrology and spawning areas is required to adequately assess the impact of the project.

6.0 Agriculture/Municipal

The benefits to agriculture are realized primarily through the control of spring flooding enabling farmers to seed lands on time as well as providing additional acres available for seeding. Appendix III provides detailed information on the impact on agriculture of the Rat River wetland project. Spring flooding to Joubert Creek will be prevented in 70% of years and flood problems in the area would be significantly reduced in 90% of years.

Information provided by SPADA indicates that approximately 1500 acres of cropland is affected by Rat River overflows. Acreage that could not be seeded is approximately 300 while 1200 acres experience seeding delays. Manitoba Department of Agriculture estimates the damage as a result of not seeding to be $85.00/acre and the loss from delayed seeding to be $42.50/acre.

Based on the frequency-damage curve (Appendix III) it is estimated that the annual average damages from Rat River flooding are $97,800. With the project in place the average damage would be considerably reduced. This would result in an average annual agricultural/municipal benefit $76,100. Benefits would also be derived through new lands brought into production and increased value to existing lands in agricultural use. The estimated net present value of the average annual benefit discounted at 5% would be $1,870,000 over 30 years and $2,089,000 over 50 years.

Disbenefits from an agricultural point are few, however farmers in the area expressed concern over the possibility of increased crop depredation from waterfowl and hunter/landowner conflicts.

Although agricultural benefits outlined are based on limited hydrological data and a number of assumptions, there are substantial agricultural benefits

possible if excess water problems can be alleviated.

7.0 Wild Fur

Based on the Rat River Swamp Wetland Development there is potential to dramatically increase muskrat production in the project area.(Appendix IV) Under optimum conditions we may assume the following.

- one muskrat house/ha suitable habitat (1 metre water & vegetation).
- estimated muskrats per house in fall = 6.
- active houses in spring = 0.5/ha.
- bank muskrat in fall = 1.5/ha

Under optimum conditions approximately 2,840 ha of suitable muskrat habitat would produce an estimated 20,000 muskrats of which 70% to 80% would be harvestable. It would require approximately 3,000 muskrats in spring for the population to reach 20,000 in the fall.

Providing there is sufficient interest and expertise on behalf of local trappers a considerable economic benefit could be realized from muskrat trapping. Optimum production would probably not be realized until year five however from that point onward the harvest of 20,000 muskrats at the average price of $5.05 would realize economic benefit discounted at 5% of $742,000 over 30 years and 960,000 over 50 years.

8.0 Recreational Hunting Values

The present value of waterfowl hunting benefits discounted at 5% to Manitoba would be $99,900.00 over 30 years and $124,000 over 50 years based on

comparing the number of resident and non-resident hunter days activity at other sites in the Province. Hunting activity would be phased in over a five year period after the completion of construction. (Appendix V.)

9.0 Project Development Cost

A 1988 feasibility study prepared by Ducks Unlimited outlined the benefits and cost of the project from a waterfowl standpoint. Estimated construction costs were based on hydrological and soils information. Development costs outlined in this section of the report are preliminary and will be refined as additional information is obtained. A 30% contingency factor is included in the cost estimates

Cost estimates (Table 1) are for the construction of dykes and control structures with dyking making up the majority of the cost. Replacement costs for controls and dyke maintenance are also included to extend the life of the project to 50 years.

Table 1. Cost summary for construction and maintenance of the Rat River Wetland Development project (Option 1).

Earthwork

Cell	Volume (m3)	Cost	Controls	Totals
Reservoir	419,797	$1,052,100		
1	178,663	345,400		
2	203,302	501,100		
3	223,877	424,600		
4	165,406	301,900		
5	157,812	303,200		
6	205,224	371,800		
7	150,984	327,000		
Cutoff	63,698	114,700		
Sub Total	1,768,763	$ 3,741,800	$491,100	$ 4,232,900
Contingency @ 30%		1,122,500	147,300	1,269,800
Total direct cost		$ 4,864,300	$638,400	$ 5,502,700
Indirect @ 10%		486,400	63,800	550,200
Total Construction Costs		$ 5,350,700	$702,200	$ 6,052,900
Waterfowl depredation prevention costs				$ 263,500
Total cost over 30 years				**$ 6,316,400**
Maintenance(years 30 to 50)		687,000	360,700	$ 1,047,700
Indirect @ 10%		68,700	36,100	$104,800
Waterfowl depredation prevention costs (year 30 to 50)				$ 85,500
Total Cost (over 50 yrs)				$ 7,554,400

10.0 Benefit /cost analysis

10.1 Option 1.

Based on the revised feasibility study completed by Ducks Unlimited in 1988 and the benefits calculated it is possible to determine a tentative benefit/cost analysis for the project (Table 2).

Table 2. Benefit/cost estimates for the Rat River Wetland Development over a 30 year and 50 year period (Option 1).

Benefits	30 Year	50 Year
Waterfowl	3,138,600	5,231,000
Fisheries	418,000	595,000
Agriculture/Municipal	1,870,000	2,089,000
Wild Fur	742,000	960,000
Recreational Hunting	99,900	124,000
Total Benefits	$6,268,500	$8,999,000
Total Costs	$6,316,400	$7,554,400
BENEFIT/COST	**0.99**	**1.19**

This benefit cost is calculated under the assumption that the entire 30% contingency factor would be required. Final construction costs and cost/benefits will vary depending on the amount of contingency funds required to complete the project.

10.2 Option 2

The second development option is available which would increase the size of the project area by approximately 268 ha.(Appendix I A) and increase benefits. This option would involve the acquisition of one parcel of private land as well as termination of an existing crown land lease. Construction costs for this option are less because of the need for less dyking. Development costs are shown in Table 3. Benefit/cost estimates for option 2 are given in Table 4.

Table 3. Cost summary for construction and maintenance of the Rat River Wetland Development project (Option 2).

Earthwork

Cell	Volume (m3)	Cost	Controls	Totals
Reservoir	419,797	$1,052,100		
1	136,215	266,100		
2	203,302	501,100		
3	223,877	424,600		
4	165,406	301,900		
5	157,812	303,200		
6	217,302	395,700		
7	190,421	398,000		
Cutoff	15,515	27,900		
Sub Total	1,729,648	$ 3,670,600	$491,100	$ 4,161,700
Contingency @ 30%		1,101,200	147,300	1,248,500
Total direct cost		$ 4,771,800	$638,400	$ 5,410,200
Indirect @ 10%		477,200	63,800	541,000
Total Construction Costs		$ 5,249,000	$702,200	$ 5,951,200
Land acquisition and lease improvements				$34,000
Waterfowl depredation prevention costs				$ 263,500
Total cost over 30 years				**$ 6,248,700**
Maintenance(years 30 to 50)		674,000	360,700	$ 1,034,700
Indirect @ 10%		67,400	36,100	103,500
Waterfowl depredation prevention costs (year 30 to 50)				$ 85,500
Total Cost (over 50 yrs)				**$ 7,472,400**

Table 4. Benefit/cost estimates for the Rat River Wetland Development over a 30 year and 50 year period (Option 2).

Benefits	30 Year	50 Year
Waterfowl (DU)	3,416,700	5,694,500
Fisheries	418,000	595,000
Agriculture\Municipal	1,870,000	2,089,000
Wild Fur	805,800	1,042,500
Recreational Hunting	99,900	124,000
Total Benefits	$6,610,400	$9,545,000
Total Costs	$6,248,700	$7,472,400
BENEFIT/COST	1.06	1.28

This benefit cost is calculated under the assumption that the entire 30% contingency factor would be required. Final construction costs and cost/benefits will vary depending on the amount of contingency funds required to complete the project.

RECOMMENDATION

The Task Force recommends development of the project under option two. The acquisition of private land and termination of the existing crown land lease should be accomplished with minimal disruption to the farmers involved.

APPENDIX I

Ducks Unlimited feasibility studies

RAT RIVER SWAMP

WETLAND DEVELOPMENT

REVISED FEASIBILITY STUDY

PREPARED BY: Dave Flavell

DUCKS UNLIMITED CANADA
Winnipeg, Manitoba
August, 1988

FORWARD

In November, 1986 a feasibility study report (Flavell and Sexton 1986) was prepared by Ducks Unlimited (DU) describing a proposal for a wetland development and flood control project in the Rat River Swamp area of southeastern Manitoba (Figure 1). This report presented development costs and waterfowl benefits estimated by DU. Subsequently, the Rat River Swamp Task Force estimated other benefits (agricultural, fur and fisheries resources) and a benefit/cost figure was determined at the Task Force Meeting on December 12, 1986. As the b/c ratio was greater than 1 (1.11), the decision was taken to proceed with further engineering studies. Subsequently, new geotechnical information obtained in 1987 indicated less favorable soil conditions for dyke construction than were available at the time of preparing the 1986 study. The decision was taken by the Task Force to review and possibly revise the proposal in light of a more complete geotechnical investigation. This report provides this new feasibility analysis.

SUMMARY

The 5300 ha Rat River Swamp area in southeastern Manitoba (Figure 1) was evaluated for potential as a waterfowl enhancement project with additional capability to protect agricultural land from flooding. A 7 cell complex with a retention reservoir is proposed. The development would prevent breakout of Rat River water overland into Joubert Creek in 70% of years and significantly reduce flows in 90% of years, thereby offering substantial protection to farmland. The total cost of development, including a 30% contingency is $6,052,900. Waterfowl production, now very limited, would increase to about 8,600 birds per year and fall staging by migrants would reach 450,000 bird-days of use annually. Benefits which may be ascribed to waterfowl during a 30 year project life would be $3,138,600. To bring the benefit/cost ratio to 1.0, benefits of $2,914,300 would be required from hunting, fur harvest, fisheries resources and agriculture.

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1. INTRODUCTION

The purpose of this report is to describe changes to the original feasibility proposal (Flavell and Sexton 1986) for Rat River Swamp. The changes were brought about due to the acquisition of new data on the surface soils of the area. Resulting alterations made to the number and area of proposed cells, the reservoir, layout and design of dykes, costs, and waterfowl benefits are described.

This report does not incorporate all aspects of the 1986 report, rather those sections which are subject to change are summarized and tables modified as required. For a more complete description of the proposal, the reader should refer to Flavell and Sexton (1986) and the benefit/cost estimates included in the 86.12.12 minutes of the Rat River Swamp Task Force Meeting.

2. METHODS

2.1 Soils

During the winters of 1987 and 1988, soils field investigations were carried out. These consisted of bag samples and descriptions from a series of 96 holes taken throughout the project along proposed dyke lines. All the holes were excavated by backhoe, to depths of 2-4m.

The bag samples were subjected to selective laboratory analysis, evaluating moisture content and grain size. Peat samples were subjected to compression testing and soil logs were prepared for each hole. A geotechnical consultant was retained who provided engineering advice on permeability, dyke design and construction methods.

3. RESULTS AND CONCLUSIONS

3.1 Geotechnical

The more extensive geotechnical investigation confirmed the original impression of surface soils consisting of tills overlain by sands and/or peats. It did, however, identify extensive areas of deep peats (up to 2m), and more areas of coarse sand or gravel lenses. These later would require key trenching of less permeable material to reduce seepage losses.

Dyke designs, which were prepared to limit seepage, especially at the reservoir and downstream limits of the project, effectively control the volume of seepage so that it does not place any limits on the project. The dykes were also designed to resist wind and wave action. Various designs were recommended, depending on soil conditions (eg. peat depth), dyke height, and exposure to wave action. Construction methods recommended were local borrow for shallower peat depths and drier conditions, and end haul from borrow pits for deeper peat areas. It should be possible to use crawler tractors and scrapers or motor scrapers for most of the work. Some ripping may be required where borrows are in till.

Unit prices for earthwork were estimated, taking into account soil conditions and construction methods. Advice from the geotechnical consultant and from Provincial Government staff (Engineering and Construction Branch, Southeastern Region), was considered in setting the unit prices.

3.2 Development Proposal

In light of the new geotechnical information, it became evident that the original dyke layout would cost substantially more than the 1986 estimate, while benefits would not change, which would result in a benefit/cost ratio falling to less than 1.0. There were also some concerns about land use conflicts, particularly relating to cells 1, 8 and 9, and the reservoir of the original proposal.

A revised proposal incorporating changed dyke alignments and cell boundaries, fewer cells and a lower reservoir FSL was developed. An attempt was made to reduce the length of dyking within the deeper peat areas (and the total length of dyking) and to realign dykes where possible into shallower peat areas. Land use conflicts were resolved by modifying the boundaries of cells 1, 8 and 9 and by lowering the reservoir FSL (the previous FSL was 294.5). It was found that FSL could be lowered to 293.5 while maintaining essentially the same total flood storage volume of the project as in the previous proposal.

Refer to Figure 2 for a plan showing the new proposal. Table 1 shows FSL's, operating levels (O.L.) and areas of the proposed basins.

3.3 Project Operation

Project operation, and the degree of flood protection provided, will be as in the previous proposal.

3.4 Potential Waterfowl Production

Waterfowl production is estimated in the same manner as described in Flavell and Sexton (1986), however, the revisions to the number and boundaries of cells have resulted in a reduced brood area and hence a reduced production estimate. A low level of production has been ascribed to the reservoir area, where previously none was attributed. The estimates are shown in Table 2.

3.5 Staging Estimates

Staging estimates are also lower due to reduced cell areas. Estimates are shown on Table 3.

3.6 Costs

As stated earlier, unit prices have been estimated taking into account advice from both the geotechnical consultant retained

TABLE 1: BASIN OPERATING LEVELS AND AREAS

Cell	FSL (m)	Summer O L (m)	Fall O L (m)	LSL (m)	Area @ FSL (ha)	Area @ Summer (ha)
1	293.0	292.6	292.25	291.25	517	475
2	292.0	291.85	291.5	290.5	973	912
3	291.0	290.85	290.5	289.25	885	830
4	289.5	289.35	289.0	287.5	531	488
5	290.5	290.35	290.0	289.0	410	385
8	298.5	298.35	298.0	297.0	353	353
9	298.5	298.35	298.0	297.0	542	510
Sub Total					4211	3953
Reservoir	293.5	293.5	Empty	Empty	1055	1055
Total					5266	5008

TABLE 2: WATERFOWL PRODUCTION

Cells	Water Area $\leq$ 1 m Deep (ha)	Birds/ha/yr	Birds/yr
1-6,8,9	2840	3.0	8,520
Reservoir	432	0.3	130
Total (per year)	3272	-	8,650

TABLE 3: WATERFOWL STAGING

Approximate water area suitable for staging(60% x 3953 ha)	2,372 ha
Approximate water area at Agassiz NWR	14,700 ha
Daily mean for waterfowl staging at Agassiz NWR	40,108 birds
Assume a 70 day fall staging period (1 Sept.- 9 Nov.) 70 days	
Estimated number of waterfowl - days staging per year at Rat River	
$\frac{(2372}{14,700}$ x 40,108 x 70)	453,030 bird-days

for this project and from Engineering and Construction Branch staff. Prices are paid on design embankment sections. Unit prices for embankment construction used in this report are as follows:

1. Local borrow (freehaul), sandy material - $1.50/m³

2. Local borrow, silty clay or till material - $1.80/m³
   -assumes some ripping may be required.

3. Overhaul - add $0.10/m³/100m to freehaul prices

The dyke volumes and costs for each cell are listed in Table 4. Total volume is 1,768,800 m³ and total cost is $3,741,600.

Control structures for this project are primarily standard DU halfround culvert controls or gated culvert controls. The main reservoir control on the Rat River is proposed to be a combination of a weir and culvert controls. Costs from the previous proposal were modified by adjusting the number of controls as required and inflating by 4% per year. Total cost of controls is $491,000.

Although the knowledge of soils is now greater than normal for a feasibility study, the 30% cost contingency has been retained in these estimates. This is due to the remaining uncertainty in quantities, haul distances, weather during construction and unit prices. Adding 30% to the sum of the dyke and control costs ($4,232,900) brings the total direct cost to $5,502,700. Indirect costs cover staffing for construction supervision. This is taken as 10% of direct costs, or $550,200. Total construction cost is then $6,052,900 (see Table 4).

Although the revised proposal has succeeded in reducing embankment volumes by about 30%, total project costs are almost the same as previously. This is due to a combination of inflation and increased unit prices due to the difficult construction condition, particularly use of hard tills for borrow and the need for endhaul for construction over deep peats. Given this rationale, the original proposal would actually have cost substantially more, as much of the deleted embankment was in areas of deep peat requiring expensive endhaul construction.

3.7 Benefit-Cost Analysis

The projected waterfowl benefits of the project include production and staging. Taking the value to waterfowl as $10 per duck produced and $0.4 per bird day of staging use, the total waterfowl benefits ascribed are $3,138,600. As the project cost is $6,052,900, benefits of $2,914,300 would be required from hunting, fur harvest, fisheries and agriculture resources to bring the overall benefit-cost ratio to 1.0. The calculation of benefits is shown in Table 5.

Table 4: COST SUMMARY TABLE

Cell	Earthwork		Controls	Totals
	Volume (m^3)	Cost		
Reservoir	419,797	$1,052,100		
1	178,663	345,400		
2	203,302	501,100		
3	223,877	424,600		
4	165,406	301,900		
5	157,812	303,200		
8	205,224	371,800		
9	150,984	327,000		
Cutoff	63,698	114,700		
Sub total	1,768,763	$3,741,800	$491,100	$4,232,900
Contingency	@ 30%	1,122,500	147,300	1,269,800
Total direct cost		$4,864,300	$638,400	$5,502,700
Indirects	@ 10%	486,400	63,800	550,200
Total Construction Cost		$5,350,700	$702,200	$6,052,900

TABLE 5: BENEFIT-COST ANALYSIS

Benefit	Value
Production: 8,650 birds/yr x $10 x 30 yr	$2,595,000
Staging: 453,030 bird-days x $.04 x 30 yr	$543,600
Total Waterfowl Value	$3,138,600
Total Costs	$6,052,900
Non-waterfowl Benefits Required for 1.0 Benefit-Cost Ratio	$2,914,300

In the previous study, waterfowl benefits were $3,779,000 and the project cost was $6,245,000. Non-waterfowl benefits needed to bring the total benefit-cost ratio to 1.0 were $2,466,000, compared to $2,914,300 now required. Non-waterfowl benefits estimated previously were $3,170,000 (Minutes, 1986). Fur benefits will likely decrease due to smaller cell areas. Use of the reservoir for fish production was not considered previously. This could potentially result in some increase in fisheries benefits. Agricultural benefits should remain unchanged but economic benefits ascribed to local hunting need to be calculated. All three items may be affected by inflation. A benefit-cost ratio very close to 1.0 is likely but benefit rates for non-waterfowl resources need to be confirmed by the Task Force.

4. RECOMMENDATIONS

4.1 Project Viability

Following presentation of this report at the September 12 Task Force meeting, Task Force members need to revise the estimated hunting, fur harvest, fisheries and agriculture benefits based on the revised proposal. The Task Force then must produce a revised benefit-cost ratio.

A PFRA representative should be invited to the next Task Force meeting (Sept.12) or subsequent meeting, in order to determine possible Federal participation in the project.

The Task Force needs to recommend direction of the project. At this time internal agency approvals would be required and negotiations must occur among all participating agencies to determine financial commitment to the project. Local governments and residents must be apprised of the outcome of this study and negotiations by the Task Force Chairman.

4.2 Concept Study

Should negotiations for cost sharing prove conclusive, further analysis toward developing a final concept is required. This work should commence January 1, 1989. This would consist of the following:

a) Completion of topographic surveys, and preparation of a contour map to a larger scale (1:10,000) and to 0.25 m contour intervals.

b) Final location of dyke lines making use of the new mapping and recent soils information. Further landowner contacts would be required at this stage.

c) A small number of additional soils holes could be required.

d) Analysis of all available data to refine the project hydrology.

e) Routing analysis to size controls and ensure project operation coincides with objectives.

f) Reevaluation of all water levels and waterfowl benefits in relation to the upgraded contour plan.

g) Preparation of cost estimate and benefit/cost analysis.

h) Preparation of report.

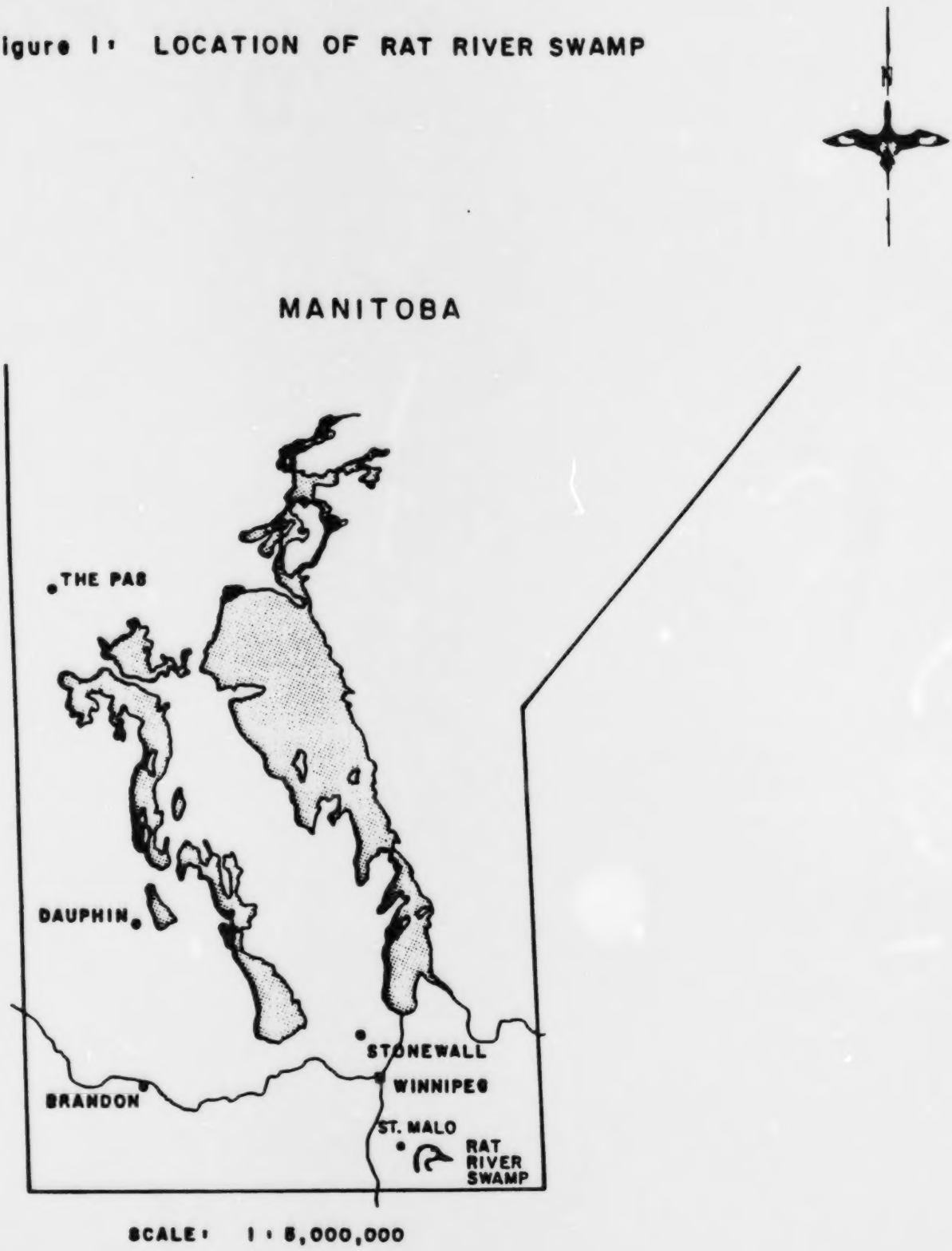
Should concept work proceed, Ducks Unlimited would provide an updated estimate of staff time and costs to carry out the necessary work. Sharing of work and costs, similar to past arrangements, would be required.

5. LITERATURE CITED

Flavell, D.R., and Sexton, D.A. 1986. Rat River Swamp Wetland Development Feasibility Study. Ducks Unlimited Canada. Winnipeg.

Rat River Task Force. 1986. Minutes, Meeting #2, December 12/86. Winnipeg.

Figure 1: LOCATION OF RAT RIVER SWAMP



Ducks Unlimited Canada

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RAT RIVER SWAMP

WETLAND DEVELOPMENT

FEASIBILITY STUDY

PREPARED BY : Dave Flavell
Don Sexton

Ducks Unlimited Canada
Winnipeg, Manitoba
November 1986

FORWARD

The Rat River in Township 3 and Ranges 6 and 7E has a history of flooding surrounding agricultural land. In 1979 the Stuartburn-Piney Agricultural Development Association (SPADA) requested a flood control project from the Province. A 1980 study found the benefit/costs to agriculture did not warrant such a development. With a portion of the area becoming a Wildlife Management Area in 1984 Ducks Unlimited (DU) was asked to estimate the potential for wetland development. As the area had good potential, meetings with the LGD, SPADA, DU and DNR were held to discuss a potential project. Extensive LGD land would be required, and in 1985 the LGD of Stuartburn passed a resolution supporting a project. In 1986 the Deputy Minister of Natural Resources struck a Task Force with members from Fisheries Branch, Wildlife Branch, Municipal Affairs, Agriculture and Ducks Unlimited. The Task Force objectives are to prepare a multidisciplinary plan to consider all resources of the area and develop a benefit cost analysis for a potential development.

The following report is a feasibility study by DU Canada on the costs of engineering works to provide water level improvements and protect agricultural land from flooding. Benefits to waterfowl are also summarized.

A feasibility study is the first step in DU's project development process, and is used to determine if a project has any potential for wetland enhancement. At this stage of study, costs are considered to be accurate to only plus/minus 30%, due to the limited engineering information used.

Where benefit/cost ratios from a feasibility study of a large project approach or exceed unity, a concept study will be done. At this stage substantially more money will be invested to obtain more detailed engineering and biological information. Positive results at this stage may lead to internal and external approval and commitment to final design and construction.

For this project, costs to carry out the concept study will be substantial. Ducks Unlimited will be seeking cost-sharing for this stage of the study from the Province. This feasibility report is, therefore, a step to determining the probable viability of the project and will form part of the basis for recommending whether monies for additional investigative work be spent by both DU and the Province.

SUMMARY

The 6000 ha Rat River Swamp area in southeastern Manitoba was evaluated for potential as a waterfowl enhancement project with additional capability to protect agricultural land from flooding. A 9 cell complex with a retention reservoir is proposed. The development would prevent breakout of Rat River water overland into Joubert Creek in 70% of years and significantly reduce flows in 90% of years, thereby offering substantial protection to farmland. Waterfowl production, now very limited, would increase to about 10,000 birds per year and fall staging by migrants would reach 500,000 bird-days of use annually. The total cost of development including a 30% contingency is $6,245,000. This produces a benefit/cost ratio over a 30 year period of 0.81, considering only waterfowl benefits.

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1. INTRODUCTION

The Rat River Swamp is situated in south-eastern Manitoba within Township 3, Ranges 6 and 7 EPM. It encompasses lands primarily under Provincial Wildlife Management Area status or having LGD jurisdiction. The area was first referred to Ducks Unlimited by the Manitoba Department of Natural Resources. A local agricultural group, The Stuartburn - Piney Agricultural Development Association (SPADA), had lobbied the Provincial Government for protection from flooding caused by Rat River waters "breaking out" of the swamp area and proceeding overland to Joubert Creek. Preliminary studies by government agencies suggested the cost of protective works would not achieve sufficient agricultural benefits to warrant a development. A recently formed Task Force, of which DU is a member, is charged with the overall objective of providing a cost benefit analysis of a multiple resource (involving wildlife and agriculture) water level control development for the Rat River Swamp.

The objectives of the proposed development are to provide the maximum area of water for waterfowl in the preferred range of depth ($\leq$ 1 m) in manageable units, and to limit breakout of Rat River water into Joubert Creek while creating no flooding on the Rat downstream of the project.

The objectives of this feasibility study are: 1) to recommend cell boundaries, operating levels and operating procedures, 2) to estimate potential waterfowl values achieved, 3) to determine the ability of a system of dykes to limit the breakouts to Joubert Creek and maintain the required water levels, and 4) to estimate the cost of the proposed works.

2. AREA DESCRIPTION

The Rat River Swamp area lies within the aspen parkland biome in south-eastern Manitoba just east of St. Malo. It covers an area in excess of 6000 ha (Figure 1). The swamp is bisected by the Rat River and is bordered on the north by Isle a Pillotte and to the south by the Vita drain. The river possesses low levees on otherwise swampy terrain. According to topographic maps there is little local relief excepting a gentle slope from east to west.

The underlying bedrock of the area consists of Jurassic sedimentary formations overlain by sandy loamy till and having peaty surface deposits of variable depth (Hopkins 1985). Repeated fires have modified surface deposits through partial or complete removal of the peat layer in the swamp area. The result has been "burn out" holes of varying sizes and configurations.

The basic habitat and corresponding vegetative communities have been summarized by Sopuck *et al.* (1985 a,b). Vegetation in the swamp is comprised principally of cattail (*Typha glauca*)/reedgrass (*Calamagrostis* spp) marshes and willow (*Salix* spp)/cattail swamp. Areas of greater elevation or better drainage have aspen (*Populus tremuloides*) and balsam poplar (*P. balsamifera*) as well as a variety of grasses and herbaceous plants. Scattered open pools of water or ponds are present in burnout areas.

Water depths rarely exceed 40 cm. In these sites water is typically hard, basic and fresh to very weakly saline. Pond sizes range from a few square meters up to 5 ha. Much of the area excepting the ponds is nearly dry by mid summer in most years.

In addition to the dense cattail stands covering most low or wet areas in the swamp, the open ponds have submergent plants present in them. Pondweeds (Potamogeton pectinatus) watermilfoil (Myriophyllum exalbescens) bladderwort (Utricularia vulgaris) and duckweed (Lemna minor) predominate although the latter two are also found in some overgrown cattail areas with standing water. Macroinvertebrates are moderately abundant in open water areas and represent a diversity of families and orders.

Adams and Butchison (1972) rated the area's waterfowl capability, which assumes continuation of the present condition, as moderate to severely limiting. Limiting factors included suspected infertility and flat topography limiting development of a variety of wetland community types.

3. METHODS

3.1 Biology

A biological evaluation of the marshes and adjacent uplands of the Rat River Swamp was carried out using standard Wetland Inventory techniques as summarized in Sopuck et al (1985 a,b). These reports also document the biological findings and recommendations used to assist in proposing cell dyke locations and water levels (Figure 1).

Basin locations were chosen to provide optimum water level diversities for wetland wildlife and to prevent holding of excessive heads of water against any one dyke. Full supply level (FSL) on each of the cells was determined using a contour map with 0.5 m intervals, at a scale of 1:20,000, and maximizing the area $\leq$ 1 m deep at summer levels in each cell. Summer (June 1) operating levels (OL) are typically 0.15 m below FSL and are reached by gradually lowering the cells after spring runoff has passed.

3.2 Hydrology

Rat River streamflow is measured at two Water Survey of Canada (W.S.C.) stations near the proposed project, namely 05OE004 Rat River near Sundown upstream and 05OE002 Rat River near St. Malo downstream. Runoff to the river from drainages between the W.S.C. gauges and the project was estimated by producing correlation curves between 1986 flow data measured at the upstream and downstream bounds of the project by the Manitoba Water Resources Branch (W.R.B.) and the flows at the W.S.C. guages. These correlation curves were then used to produce a set of flows for the Rat at the bounds of the project for the period 1960-1985.

The river flow data were then divided into runoff volumes for the spring runoff period April and May and the summer/fall runoff period June to October. These time periods coincided with operating periods for the marshes.

Net precipitation and evaporation for the periods November to May and June to October for the project area were estimated from the PFRA report "Precipitation and Evaporation Tables 1911-1984", October 1985. These values were applied to the surface area of the project for the appropriate time periods.

As one of the primary objectives of the project is to eliminate uncontrolled overflow from the Rat River to Joubert Creek, it was necessary to estimate the historical volumes lost to Joubert. As these flows have not been measured directly, it was necessary to estimate them indirectly using a storage equation:

overflow to Joubert = Rat flow at P.R.208 (u/s boundary of project)

- Rat flow east of Rosa (d/s boundary of project)

+ net precipitation - change in storage

The change in storage amounts were estimated by applying stage-discharge curves to the flows in the Rat at October 31 and May 31, then applying the resulting stages to a slope-modified stage-storage curve for the entire project. Estimated pre-project overflow volumes to Joubert Creek for selected frequencies of exceedance are as follows:

TABLE 1: PRE-PROJECT OVERFLOW VOLUMES TO JOUBERT CREEK

Season	Runoff Event		
	90% (dam^3)	50% (dam^3)	10% (dam^3)
spring	11,000	26,000	40,000
summer/fall	0	20,000	43,000

These numbers can be interpreted for example by saying that the spring overflow has been 26,000 dam^3 or more about once every two years and 40,000 dam^3 or more about once in every ten years.

Estimation of post-project flow to Joubert Creek will be discussed in the section on project operation.

3.3 Soils

A soils field investigation was carried out, consisting of descriptions and bag samples obtained from a series of 22 holes taken throughout the project along proposed dyke lines. Fifteen of the holes were done by hand auger, and reached depths of one to three meters. Seven were test pits using a backhoe, and were taken to depths of two to four meters.

The bag samples were subjected to laboratory analysis, and a report was prepared providing descriptions, moisture contents and grain size distributions.

A soils consultant was retained who provided preliminary engineering advice on permeability, constructability and dyke design. He also provided a map showing general patterns of surface soil distribution, obtained by aerial photo interpretation methods together with reference to the test results.

4. RESULTS AND CONCLUSIONS

4.1 Development Proposal

The proposal (see Figure 1) provides for construction of dykes to create 9 independently controlled cells and a storage reservoir, incorporating a total area at FSL of 5974 ha. The cells would lie on either side of the Rat River. The reservoir, which would span the river upstream of cells 1 to 7, would be used to store flood waters, top up cells and provide riparian flow on the Rat. It would be emptied by fall every year. Refer to Table 2 for a list of FSL's, operating levels and areas of the proposed basins.

TABLE 2: BASIN OPERATING LEVELS AND AREAS

Cell	FSL (m)	Summer O L (m)	Fall O L (m)	LSL (m)	Area @ FSL (ha)	Area Summ (h
1	293.0	292.85	292.5	291.25	881	860
2	292.0	291.85	291.5	290.5	964	915
3	291.0	290.85	290.5	289.25	890	845
4	289.5	289.35	289.0	287.5	445	414
5	290.75	290.6	290.25	289.0	399	394
6	292.0	291.85	291.5	290.25	218	218
7	293.5	293.35	293.0	292.0	569	569
8	298.5	298.35	298.0	297.0	354	346
9	298.5	298.35	298.0	297.0	392	384
Reservoir	294.5				862	

The dykes are designed with a 3.65 m top width and 3:1 side slopes. A 3 m berm is provided on the deep water side to protect against wave action. The crest is 1 m above FSL to protect against flood levels together with wind and wave action.

All cells would have control structures to spill excess runoff to the river. Drawdown for managing marsh vegetation will also be accomplished by draining to the river. Water supply to cells 1 through 7 will be via the reservoir and bypass channels. Cells 8 and 9 will be supplied directly from the river.

Control structures are typically gated culverts for inlet controls and culverts with stoplog controls for outlet structures. The main control on the reservoir leading to the Rat River is a combination of stoplog culvert controls and a weir.

The proposed dyking along the north side of the river to form the cells, together with a spur along the north of 21 and 22, Twp.3, R7E, would limit breakouts from the Rat into Joubert Creek. If required, some water could be passed into Joubert Creek in spring for riparian flow and water table management except in very dry years.

4.2 Project Operation

The operating objectives which guided the study can be divided into marsh habitat objectives and flood control objectives. The approach taken was to simulate the operation of the marsh to meet the habitat objectives, then determine how well the flood control objectives were met. If not perfectly met, both habitat and flood objectives were selectively relaxed until an operation was determined which was acceptable for both.

The marsh habitat objectives initially stated are as follows:

> During normal operation, each cell will rise to near its FSL or above during spring runoff, but will be lowered to FSL - 0.15 m (summer operating level (O.L.)) by June 1. Each cell will then be allowed to drop further throughout the summer and fall to a level typically 0.5 m below FSL. (This latter measure is partially for habitat maintenance, but more to provide storage for flood control.)

The project will also be subject to drawdown operation. Each cell will receive a drawdown in a cycle of about 8 years. The drawdown will occur in the fall and be held through the spring of year 1. The water level will be raised about 0.15 m in the late summer of year 1 and a further 0.35 m in the spring of year 2. Normal operation will resume in the spring of year 3. A specific drawdown schedule was developed for use in the simulation study.

The flood control objectives initially adopted were:

Limit uncontrolled overflow to Joubert Creek to minimal values in most years, while at the same time do not allow any increase to the flood volumes released to the Rat River downstream of the project, relative to historical values.

Given the initial objectives, a simulation of the project operation was carried out for the 26 year period of record. Overflow volumes to Joubert were calculated as the difference between inflows at PR208 plus net precipitation, and historical outflows to the Rat east of Rosa plus volumes which could be stored in the project.

The initial simulation showed that, while spring volumes overflowing to Joubert in a 50% year were reduced from 26,000 to 7,500 dam^3, volumes in a 10% year remained high at 29,500 compared to 40,000 dam^3 pre-project. The habitat objectives were then relaxed such that O.L. was reached by May 31 in only 80% of years rather than every year. Further, the size of cell 7 was reduced to provide a larger storage reservoir. These modifications, however, only decreased the 10% overflow to 25,500 dam^3 which was still deemed to be unacceptable.

The judgement was then made that some increase to the spring discharges in the Rat River downstream of the project would be acceptable. It was found that historically, the mean flow during April and May averaged about 50% of the maximum mean daily discharge during that time period. Increasing the mean April and May flow to 75% of the peak in above average runoff years provides a substantial additional volume to be removed from the overflow to Joubert. The result would be to reduce spring overflow to 6,000 dam^3 in a 10% year and to zero in a 30% year. Table 3 compares pre and post project uncontrolled spring overflows. This operation should provide the level of flood protection desired by the agricultural interests.

TABLE 3: PRE AND POST PROJECT SPRING BREAKOUTS TO JOUBERT CREEK

Time Period	Runoff Event		
	50% (dam^3)	30% (dam^3)	10% (dam^3)
pre-project	26,000	31,000	40,000
post-project	0	0	6,000

The project would reduce mean spring (April and May) flow rates in low flow years. A riparian flow of 0.85 m^3/sec (30 cfs.) was selected, equal to the 90% mean spring flow. In addition to the one year in ten the flow would naturally be less than or equal to that value, there would be two additional years in ten when the natural flow would be reduced to the riparian value. It should be noted however that the St. Malo Reservoir was designed for a firm flow of 5 cfs., which was considered to be adequate for all municipal and agricultural needs downstream on the Rat River projected to the year 1995 (Water Control and Conservation Branch, 1960). The selected spring riparian flow is six times that value.

Although in lower flow years no overflow to Joubert need occur, the droughty nature of the agricultural soils may require that some small flow be passed to Joubert Creek for water table management. Water can be supplied for this purpose in all but extremely dry years, and control structures will be built for this purpose. Some shallow channelization may be desireable to confine and direct this flow.

Summer/fall flow rates in the Rat River will be substantially increased over pre-project levels. Taking into account a small flow to Joubert Creek, runoff volumes would be increased from about 2400 dam^3 to 14,000 dam^3 in a 90% (dry) summer, 13,000 dam^3 to 50,000 dam^3 in a 50% (average) summer, and 34,000 to 90,000 in a 10% (wet) summer. It is expected that these increases would be beneficial in terms of water quality in the river and in St. Malo Reservoir.

4.3 Soils

Because of the sandy nature of the soils in the area, there is concern as to whether the dyked impoundments can maintain the required water levels during the summer lower flow periods and in low runoff years. The soils information obtained was analysed in light of this concern.

In the majority of holes, a very sandy material, with small fractions of clay, silt and sometimes gravel, overlies an impermeable, well-graded sandy silt till. The overlying layer of sand is generally 1 to 3 feet thick.

At most of the above locations, the sand is very fine, and/or has a sufficient fraction of clays and silts, such that it is a fairly tight material, i.e. seepage rates will be low. Seepage volumes calculated over the entire project for this material are inconsequential.

At a few holes, the sand was more well graded and contained some gravel. In these areas it may be necessary to provide a shallow key of till material to cut off the seepage.

There were two holes where the sands extended to 8 to 10 feet. In these areas it may be necessary to attempt to relocate the dykes.

In the summer there is a substantial water supply available from the Rat River and from the reservoir to replace seepage losses. A frequency analysis of the water available from those sources, in excess of the needs of the 9 cells, shows the following:

TABLE 4: SUMMER WATER SUPPLY

Runoff Event	Volume Available (dam^3)
90%	20,000
50%	56,000
10%	96,000

It may be necessary to continue to pass some water to Joubert Creek during the summer months for water table management. Assuming a flow to Joubert Creek of 0.75 m^3/s, about 6,000 dam^3 would be passed from June to August. This would still leave 14,000 dam^3 or more available for seepage replacement in 9 years out of 10. Note also that most seepage flow would find its way into either the Rat River or Joubert Creek, therefore water used for seepage replacement would not deplete the natural flow of the river.

Based on the above, the prognosis for being able to maintain the proposed water impoundments is positive. It must be stated, however, that it would only take a few small areas of highly permeable soil to dramatically increase the total seepage volumes. A detailed field soils investigation and analysis would be required to prove up the water holding capability of the system, to relocate dyke lines where required and to provide parameters for final dyke design.

4.4 Potential Waterfowl Production

With the increase in water permanency as a result of the impoundments and the improvement in vegetation interspersion through water level management, waterfowl production should increase dramatically. Currently duck production is low due to limited open water and impermanence in all but wet years.

Post development waterfowl production estimates are based upon extrapolations from detailed brood surveys of DU project areas considered to have comparable habitat conditions and located in the same or similar biomes. The per unit (broods per hectare) duck production value is a composite average of several projects, assuming the proposed project will develop similarly to those surveyed.

From estimates of average summer water levels post development, cells 1 through 9 excluding cell 7 will contain 3340 ha of water $\leq$ 1.0 m deep and cell 7, 387 ha $\leq$ 1.0 m deep. The 0-1 m range is considered to be the optimum area for brood use and is hence considered the "productive" portion of the cell for waterfowl. Because cell 7 will periodically not reach FSL or even OL, the per unit waterfowl production was reduced by 50%. This assumes cell 7 will be too shallow and lack optimum habitat conditions. As the reservoir will rarely hold water through the summer period it is only considered habitat for breeding pairs.

TABLE 5: WATERFOWL PRODUCTION

Cells	Water Area $\leq$ 1 m Deep (ha)	Birds/ha/yr	Birds/yr
1-6,8,9	3338	3.0	10,014
7	387	1.5	581
TOTAL (per year)	3725	-	10,595

4.5 Waterfowl Staging

Following development, the large area of wetland, good quality habitat and relative protection afforded by the large cell areas will undoubtedly attract many more migrant waterfowl; both ducks and geese. Presently the few open ponds hold ducks and occasionally geese in autumn.

Estimating the post development staging population is difficult. However, data are available from two comparable areas in similar habitat in Minnesota; the Agassiz National Wildlife Refuge and Roseau River Wildlife Management Area some provide some insite.

To provide an estimate of potential staging numbers the area of suitable habitat at Rat River Swamp was estimated taking into consideration annual operations such as drawdown of at least one cell and fall lowering of all cells. This leaves about 60% of the total area as useful habitat for migrant waterfowl. This area was then proportioned to the Agassiz NWR water area and multiplied by the average daily waterfowl staging estimates there for 1981 through 1985 (unpublished data).

The calculation of estimated potential waterfowl staging at Rat River is summarized in Table 6.

TABLE 6: WATERFOWL STAGING

Approximate water area suitable for staging(60% x 4370 ha)	2,620 ha
Approximate water area at Agassiz NWR	14,700 ha
Daily mean for waterfowl staging at Agassiz NWR	40,108 birds
Assume a 70 day fall staging period (1 Sept.- 9 Nov.) 70 days	
Estimated number of waterfowl - days staging per year at Rat River	
$\frac{2620}{14,700} \times 40,108 \times 70$	500,395 bird-days

4.6 Costs

The costs consist entirely of dyking and control structures, with dyking making up the bulk of the cost (Table 7). There is no pumping involved, and channelization is minimal. The two bypass channels will be formed from borrow for the dykes. Cost for any channel work to convey water to Joubert Creek is not included.

In the drier areas the dykes can be constructed with cat and scraper and a unit price of $\$1.30/m^3$ was used. In the wetter areas and along the river levees a backhoe or dragline may be required, and a unit price of $\$1.65/m^3$ was used. The dyke volumes and costs for each cell are listed in Table 7. Total volume is 2,541,000 m^3 and total cost is $3,860,000. Total cost of controls is $507,000.

Adding a 30% contingency to the sum of dyke and control costs ($4,367,000) brings the total direct cost to $5,677,000. Indirect costs cover staffing for construction supervision. This is normally about 10% of direct costs, or in this case $568,000. Total construction cost is then $6,245,000. Costs are tabulated in Table 7.

Table 7: COST SUMMARY TABLE

Cell	Earthwork		Controls	Totals
	Volume (m^3)	Cost		
Reservoir	362,129	$538,763		
1	306,108	459,791		
2	253,799	379,990		
3	253,294	386,827		
4	242,348	360,717		
5	226,040	326,756		
6	167,927	255,800		
7	273,209	398,725		
8	211,822	349,506		
9	237,562	391,977		
Cutoff	6,694	11,045		
Subtotals	2,540,900	$3,859,900	$507,000	$4,367,000
Contingency @ 30%		1,158,000	152,000	1,310,000
Total direct cost		$5,018,000	$659,000	$5,667,000
Indirects @ 10%		502,000	66,000	568,000
Total construction cost		$5,520,000	$725,000	$6,245,000

4.7 Benefit - Cost Analysis

The projected waterfowl benefits of the project include production and staging. Assuming a value to waterfowl of $14 per duck produced and $0.04 per bird day of staging use, the value can be calculated as follows over a 30 year project agreement. (Note that, although $14 per duck is the stated maximum that DU will spend, on larger projects approval is normally only obtained for a value up to $10 per duck.)

TABLE 8: BENEFIT-COST ANALYSIS

Benefit		Value
Production:	10,595 birds/yr x $14 x 30 yr	$4,449,900
Staging:	500,395 bird-days x $.04 x 30 yr	$600,500
Total Waterfowl Value		$5,050,400
Total Costs		**$6,245,000**
Waterfowl Benefit-Cost Ratio		**0.81**

5. RECOMMENDATIONS

5.1 Rat River Flows

It is recommended that the Province determine whether the proposed method of operation, including increases to mean spring flow rates on the Rat River in wetter years, and decreases in lower flow years, is acceptable.

5.2 Project Viability

Waterfowl benefits, together with expected benefits from other wildlife and agriculture (Schellenberg, 1986), are close to the total estimated costs. The non-waterfowl benefits need to be firmed up. However, given that the method of operation is deemed to be acceptable, it is DU's recommendation that planning towards the next stage of study should proceed.

5.3 Soils

It is recommended that a further field investigation and laboratory analysis be carried out this winter. A soils consultant would also be retained to provide engineering advice. The purpose is to fill gaps in the information in the central area of the project and along the river levees, and to more intensively investigate the areas with deep sands. The program would allow a tighter estimate of project costs, and determine whether seepage concerns can be allayed.

5.4 Mapping

Should the results of the soils program prove positive, it is recommended that a larger scale (1:10,000) contour map be prepared to a 0.25 m contour interval, utilizing a mosaic background prepared from recent aerial photography. For this purpose a topographic survey, approximately equal in magnitude to that done last winter, would be required. Ideally, this survey should also be done this winter.

5.5 Concept Study

A Ducks Unlimited concept study would lead to a cost estimate with a variability of plus/minus 20%. This would form the basis of the final decision as to whether to proceed with the project. The study would consist of the following steps:

a) Further collection of stage and flow data on the Rat River and overflow sites in 1987. Adjustment of hydrologic data from feasibility study as required.

b) Final location of dyke lines making use of the new mapping and soils information to optimize cell water depths, take detailed account of land use, minimize clearing, and avoid problem soil areas where possible. Final location of control structure sites.

c) Further biological analysis to firm up waterfowl production estimates and finalize water levels and operation.

d) Sizing of control structures and preparation of stage-discharge curves. Routing of flood hydrographs to ensure project operation coincides with objectives. Adjusting of controls and re-routing until operation is satisfactory.

e) Preparation of cost estimate and benefit/cost analysis.

f) Preparation of report.

5.6 Costs and Cost-Sharing

Soils program costs are estimated to be about $25,000 ($15,000 for field work and $10,000 for laboratory work and engineering). Topographic surveying costs are estimated at $35,000, and mapping at $20,000.

It is recommended that Ducks Unlimited and the Province share the above costs equally, including an arrangement to utilize in-house staff for portions of the work. DU does not have in-house staff available.

Ducks Unlimited staff would carry out most of the engineering work associated with the remainder of the concept study as described above. It is, however, requested that Provincial staff carry out the stage and flow measurements on the Rat River.

6. LITERATURE CITED

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APPENDIX I A

Development Option 2

The second development option which is available would increase the size of the project area by approximately 268 ha. This option would involve the acquisition of one parcel of private land as well as termination of an existing crown land lease. Construction costs for this option are less because of the need for less dyking.

TABLE 5: BENEFIT-COST ANALYSIS

Benefit	Value
Production: 9,454 birds/yr x $10 x 30 yr	$2,836,200
Staging: 483,780 bird-days x $.04 x 30 yr	$580,500
Total Waterfowl Value	$3,416,700
Total Costs	**$5,951,200***

* Does not include land purchase, compensation costs.

Table 4: **COST SUMMARY TABLE**

Cell	Earthwork		Controls	Totals
	Volume (m^3)	Cost		
Reservoir	419,797	$1,052,100		
1	136,215	266,100		
2	203,302	501,100		
3	223,877	424,600		
4	165,406	301,900		
5	157,812	303,200		
8	217,302	395,700		
9	190,421	398,000		
Cutoff	15,516	27,900		
Sub total	1,729,648	$3,670,600	$491,100	$4,161,700
Contingency	@ 30%	1,101,200	147,300	1,248,500
Total direct cost		$4,771,800	$638,400	$5,410,200
Indirects	@ 10%	477,200	63,800	541,000
Total Construction Cost		$5,249,000	$702,200	$5,951,200

TABLE 1: BASIN OPERATING LEVELS AND AREAS

Cell	FSL (m)	Summer O L (m)	Fall O L (m)	LSL (m)	Area @ FSL (ha)	Area @ Summer OL (ha)
1	293.0	292.6	292.25	291.25	666	578
2	292.0	291.85	291.5	290.5	973	912
3	291.0	290.85	290.5	289.25	885	830
4	289.5	289.35	289.0	287.5	531	488
5	290.5	290.35	290.0	289.0	410	385
8	298.5	298.35	298.0	297.0	418	413
9	298.5	298.35	298.0	297.0	648	615
Sub Total					4531	4221
Reservoir	293.5	293.5	Empty	Empty	1055	1055
Total					5586	5276

TABLE 2: WATERFOWL PRODUCTION

Cells	Water Area $\leq$ 1 m Deep (ha)	Birds/ha/yr	Birds/yr
1-6,8,9	3108	3.0	9324
Reservoir	432	0.3	130
Total (per year)	3540	-	9454

TABLE 3: WATERFOWL STAGING

Approximate water area suitable for staging(60% x 4221 ha)	2,533 ha
Approximate water area at Agassiz NWR	14,700 ha
Daily mean for waterfowl staging at Agassiz NWR	40,108 birds
Assume a 70 day fall staging period (1 Sept.- 9 Nov.) 70 days	
Estimated number of waterfowl - days staging per year at Rat River	
$\frac{(2372}{14,700}$ x 40,108 x 70)	483,780 bird-days

APPENDIX I B

Waterfowl Disbenefits

PROPOSED RAT RIVER DEVELOPMENT

Issue: Waterfowl Crop Damage Prevention Program proposal to address the forecasted waterfowl depredation which will occur with development of the Rat River marsh.

Background: The levels of agricultural crop damage which has occurred in the area affected by the marsh development has been low. Between 1982 and 1985 there were only two applications for waterfowl compensation payments, both occurring in 1985 (considered a severe depredation year) for a total cost of $8,300. The number of waterfowl depredation complaints registered with area Natural Resources Offices have also been low. In 1985, eleven complaints were actioned by Natural Resources staff while in 1986 and 1987 only 2 and 3 complaints were actioned, respectively. Most complaints and compensation payments have occurred to the south of the proposed marsh development, see attached figure.

The marsh development will produce approximately 8,000 new resident ducks and will also attract additional waterfowl for staging. It is anticipated that the marsh will have 500,000 bird use days in the fall each year.

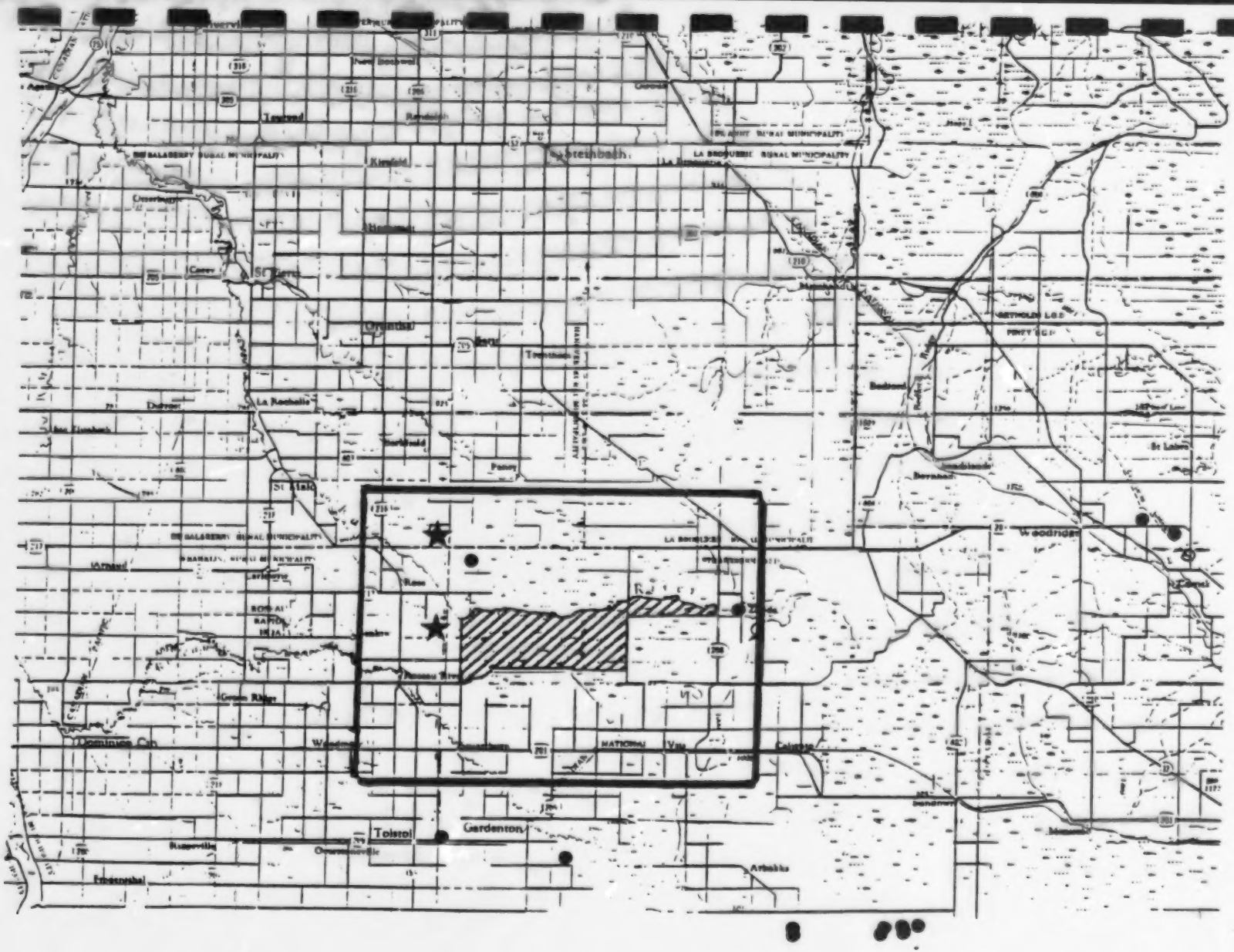
To address the additional waterfowl depredation in the area, marsh development should incorporate one of the following damage prevention options:

1) Crown land lure crops and a scaring program. Approximately 100 acres of barley crop production would be required annually. The lure crop should be in two separate parcels on productive land as close to the marsh proper as possible. Annual crop production costs would approximate $7.0. The scaring program would incur initial start-up costs of about $30.0 for propane scare cannons, an ATV and a equipment storage shed. Ongoing scaring costs would approximate $10.0-$15.0.

2) Feeding station and scaring program. The feeding site would have to be constructed at a yet undetermined cost. Annual operating cost of the feeding station would approximate $12.0. Scaring costs would be the same as in 1.

Concerns: With option 1, lure crops are a committed cost even when the crop may not be required because of an early harvest.

With option 2, high initial construction cost and the birds are tied up in a refuge situation and not available to hunters.



★ COMPENSATION CLAIMS

● DEPREDATION COMPLAINTS

APPENDIX II

Fisheries benefits and disbenefits

RAT RIVER SWAMP PROJECT

FISHERIES BENEFITS: PROJECTED

A number of critical assumptions have been made in calculating fisheries benefits. If they do not prove to be realizable benefits may be zero or close to zero.

These are:

1) There will be a demand for walleye fingerlings in the Southeastern and Southwestern portion of Manitoba over the life of the project.

2) That the survival rate for fingerlings will be 5%. (This would produce approximately 75,000 fingerlings/year.)

3) That in years 1-7 the project cells will be full and after that time one cell a year will be available for fingerling production in years 8-30.

4) That water used to fill the cell stocked is screened to prevent access of any other fish species which may result in competition for food or space or that may result in predation.

5) That the cell drawdown experiences total winterkill prior to walleye fry stocking.

6) That there will be entrapment devices installed on the outlet controls of the cells used which will facilitate capture of fingerlings.

7) That annual costs for transportation will be $10.0.

8) That each fingerling would be worth 96¢ when stocked into Southern Manitoba waters.

If these assumptions are correct, the first fingerlings would be available in year 8 or 9 and continue to year 30. This would give a present net value of the annual benefits discounted at 5% over the life of the project of $418,000.

... 2

Our original estimates have changed for the following reasons:

1) Projected survival rate was decreased from 10% to 5%/annum to allow for success only every second year.

2) Value of fingerlings decreased from $1.26 to $.96 because of location of stocking.

3) Transportation costs increased from $7.0 to $10.

4) Cells first became available in years 8-9 so only 22-23 years are production.

DISBENEFITS:

There appears to be potential reduction in spawning opportunities below St. Malo Reservoir. This is because of the riparian flow projected in 3 of 10 years. More information is necessary to determine this and Water Resources is currently examining the bank full flows now required below St. Malo.

- Other comments and concerns are much similar to those in the existing draft.

APPENDIX III

Agriculture benefits

Manitoba

Agriculture

Farm and Rural Development

P.O. Box 160,
Dugald, MB
ROE OKO
October 18, 1988.

Mr. Tom Moran,
Secretary,
Rat River Ducks Unlimited Project,
139 Tuxedo Blvd.,
Winnipeg, MB

Dear Mr. Moran:

RE: RAT RIVER PROJECT

On October 13th I met with a group of landowners and area elected officials concerning the Rat River Project. The following topics were discussed:

1. Potential new agriculture land.
2. Land which would be improved by the project.
3. Private and Crown lands in the proposal.

1. **POTENTIAL NEW LANDS**

The group reviewed the area affected and determined that approximately 5,000 acres could be brought into production. In considering the value of this new land, it was determined that after cost of land development has been included, the value would be $50.00 per acre for a total value of $250,000.

2. **VALUE ADDED LAND**

It is estimated that approximately 6,000 acres of land will have an improved value because of the project. It is estimated that this value would be in the $75.00 per acre range, giving a total value of $450,000.

3. **PRIVATE AND CROWN LANDS WITHIN THE PROPOSAL**

The two parcels of private land and one parcel of Crown Land were discussed. It was felt that these lands have low agricultural capability and should be included in the project. In the case of the Crown Land lease in the W 1/2 of 7-3-7E, arrangements can be made with the lessee to overcome any difficulties incurred by the lease cancellation.

In summary, it is estimated that total agricultural benefits will increase by approximately $700,000 by bringing new lands into production and improving the value of other lands.

Sincerely,

Bruce MacLean,
Land Resource Specilist.

BM/jt

Manitoba

Natural Resources

Water Resources Branch
1577 Dublin Avenue
Winnipeg, Manitoba
R3E 3J5

December 3, 1986

FILE: 4 4 2

DEC 10 1986

Mr. D. Flavelle
Ducks Unlimited
#5 - 1325 Markham Road
WINNIPEG, Manitoba
R3T 4J6

Dear Dave:

As discussed at the November 7, 1986 Rat River Task Force Meeting, Herb Schellenberg and I have developed additional agricultural/ municipal damages information. Please find attached a table indicating estimated damage costs for various Rat River flood events and flood frequency-damage curves which were developed using this information.

Based on the frequency-damage curve, it is estimated that the present annual average damages due to Rat River flooding are $97,800. With the Ducks Unlimited project in place, it is estimated that the annual average damages would be reduced to about $21,700. This would result in an annual average agricultural/municipal benefit of about $76,100. The net present value of these annual average benefits, discounted at 5% over a 30 year Ducks Unlimited project agreement, is $1,170,000.

Yours truly,

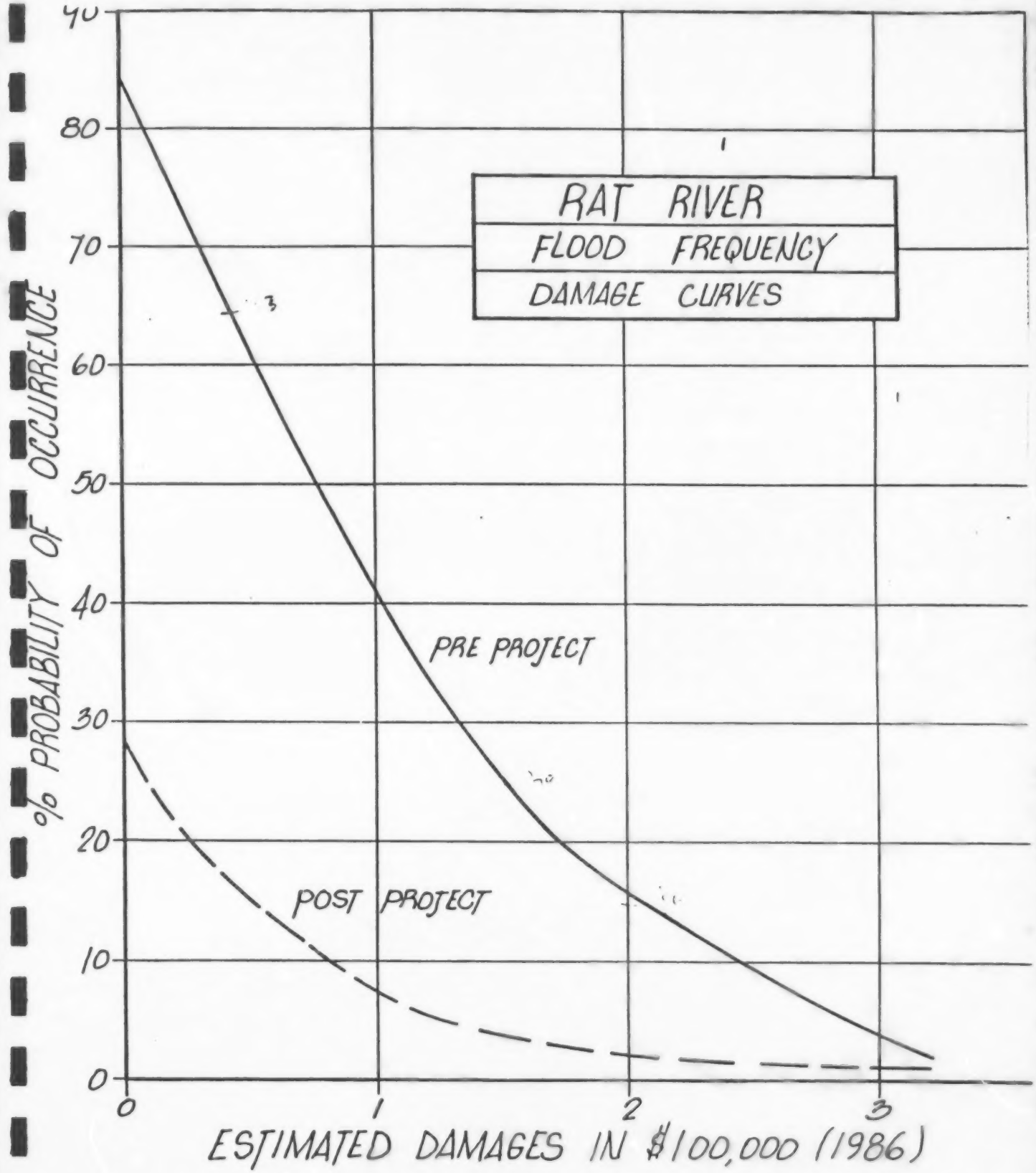
J. Smithson, P. Eng.
Senior Planning Engineer
Water Conservation & Development

JS/jj

Attachment

RAT RIVER FLOODING - DAMAGES

Year	Flood Frequency %	Maximum Daily Discharge (m^3/s)	$ Total Damages
1986	15	21.9	208,000
1983	65	10.8	43,000
1979	25	17.8	151,000
1974	2	34.3	318,000


RAT RIVER
FLOOD FREQUENCY
DAMAGE CURVES
PRE PROJECT
POST PROJECT
% PROBABILITY OF OCCURRENCE
90
80
70
60
50
40
30
20
10
0
0
1
2
3
ESTIMATED DAMAGES IN $100,000 (1986)

Manitoba

1 1 2

Memorandum

Date June 5th, 1986

To Dick Robertson,

From Robert E. Jones,
Wetland Habitat Specialist

Telephone 857-9711 Ext. 260

Subject HERB SCHELLENBERG'S AGRICULTURAL REPORT

on the Rat River

Please find enclosed the preliminary report giving estimates of agricultural damage that would be partially prevented by control of the overflow. The hydrological study that they recommended was initiated this spring and there may be further damages that this report will describe.

REJ/ld
encl.
c.c. Rick Wishart

First | Fold

MANITOBA AGRICULTURE

AGRICULTURAL REPORT

RAT RIVER SWAMP PROJECT

PREPARED BY:

Herb Schellenberg
Ag. Resource Economist
Policy Development Branch

Winnipeg, Manitoba
February 11, 1986

WITH ASSISTANCE OF:

Larry Slevinsky
Soil Management Specialist
Soils and Crops Branch

Rod Siemens
Crops Specialist
Steinbach

Wally Happychuk
Agricultural Representative
Vita

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AGRICULTURAL REPORT: RAT RIVER SWAMP PROJECT

1.0 Background

Ducks Unlimited (Canada) is currently investigating a proposal to enhance wetland wildlife habitat along the Rat River, just north of Vita, in southeastern Manitoba.

Farmers in this reach of the Rat River have been plagued by a continual problem of flooding and excessive wetness from Rat River overflows. In this area, the capacity of the Rat is very limited and overflows occur almost annually.

The DU project would contain six or seven wetland cells and, possibly, a reservoir to assist in regulating water supplies. The north boundary of the project would effectively contain the Rat River in a significant portion of the agriculturally flooded area. However, about three to four miles of additional works consisting of a dyke/ditch would be required to fully contain the Rat River from breakouts to the north. These additional works would be totally for the benefit of agriculture, hence provincial funding assistance has been requested.

The Stuartburn-Piney Agricultural Development Association (SPADA) has made several representations to the Manitoba Government on behalf of about 20 farmers in the area who are affected by flooding. The organization is supported in this matter by the LGD of Stuartburn in which the project would be located. As LGD lands would be required for the wildlife components of the project, the local people will only be in favour of the project if the agricultural flooding problems are resolved.

In 1980, the Water Resources Branch conducted engineering investigations in the study area and concluded that the cost

of the works could not be justified by the agricultural benefits. In 1982, the Branch reviewed their earlier studies, following a brief by SPADA, and confirmed their earlier conclusion. A reservoir in the vicinity of the "island" was discussed but use of the reservoir for flood control would not be compatible for wildlife.

By 1985/86, the perspective has been reversed. Much of the costs of controlling the Rat River can now be borne by works to enhance wildlife habitat.

2.0 PURPOSE OF REPORT

The purpose of this report is to examine the DU project and supplementary agricultural works and to prepare a preliminary documentation of the problems and economic viability of the project from an agricultural viewpoint.

3.0 REPORT FINDINGS

3.1 Flood Frequency

Other than the SPADA brief, a review of files indicated that there was very little factual information on the frequency of overflows.

Frequency is required to calculate average damages. The SPADA brief claimed that about 1,500 acres were directly affected each year by flooding, in wetter years this acreage would be substantially higher. An additional 1,000 acres of forage land were affected while another 1,500 acres of agricultural land were made inaccessible by flooding.

According to SPADA, spring flooding of the Rat River affects farmers by delaying spring seeding or making seeding impossible, reducing the selection of crops, making some land inaccessible and destroying established forage stands.

Mr. R. Harrison, Senior Hydrologist, Manitoba Water Resources Branch, provided hydrologic information regarding Rat River flows as measured at the Sundown guaging station, upstream of the study area. Maximum daily discharges are shown in Table 1 from 1960 to 1985, the period of record at this site.

As shown in the table, 1985 had the lowest maximum daily stream flow on record in the area. Smaller spring flows were also recorded recently in 1981, 1980, 1977, 1976, 1975 and 1973. Higher flows were recorded in 1984, 1982, 1979 and 1974.

Stream flows, however, do not accurately indicate the flooding frequency in the problem area. In the region of Rat River overflows, the river has low levees which slope gently to the surrounding lowlands. Stream capacity, according to the 1980 Water Resources Study, is as low as 1.76 m^3/sec (62 cfs), the same as the 1985 peak discharge. Overflows are subsequently a yearly occurrence, with the amount of water affecting the overflow area dependent upon the time stream-flows are above channel capacity. Ice jams can also affect, on an unpredictable basis, the amount and frequency of flooding.

Once the river has escaped its channel, much of the flow is northward, into the Joubert Creek.

It would be most useful, in the spring of 1986, to conduct detailed flow studies in the affected area.

3.2 Soils

Canada-Manitoba Soil Survey has recently conducted a detailed soil survey in the study area. The soils are predominately loams and sands overlying stony, medium-textured till or sandy outwash and lacustrine deposits. Most of the

soils used for agricultural cropping are "wet sands", characterized by excessively wet or droughty nature. Large areas of organic soils also are located in the area, generally underlain by the medium-textured tills.

The soils have high water tables. If crops can become established and are not flooded out, the potential for large yields is high due to the abundant moisture supplies in the rooting zone.

Croplands in the flood-prone area are mostly 3M, 3MW, 3W, 4W and 4PW agricultural capability. Class 3 soils have moderately severe limitations that restrict the range of crops or require special conservation practices. Class 4 soils have severe limitations restricting the range of crops and/or requiring special conservation practices. Subclass W refers to excess water, M to droughtiness and P to stoniness.

In this area it is likely that the wetness limitation would be considerably alleviated with the control of Rat River overflows. Water management should, therefore, strive to control the flooding problem while regulating the water table within the rooting zone of crops. Even with resolution of the Rat River flooding problem, shallow drains may be required to remove excess moisture from snowmelt or precipitation, or leakage through or under the DU and supplementary works. These shallow drains would direct water northward into the Joubert Creek.

3.3 Farmer Survey

Most of the farmers in the affected area were surveyed in December, 1985, to obtain their latest experiences regarding flooding.

Farmers were requested to indicate flooded lands or excess water problems due to Rat River overflows, to estimate

the area of cropland and affected forages for each year in recent memory, to estimate yield reductions, and to indicate how cropping or land use might change with control of overflows.

3.3.1 Affected Area

Most of the lands directly affected by Rat River overflows are located in Township 3, Range 7E, with about 1,120 acres of cropland reported. In Township 3, Range 6E, another 160 acres of cropland were reported.

These totalled to about 1,300 acres of cropland. The 1980 SPADA brief indicated about 1,500 acres of cropland were affected by the Rat River.

Another 1,000 acres of pasture land were reported in the 1985 survey, the same as indicated earlier by SPADA.

Affected lands are located mostly on the following sections:

TWP 3, RGE 7E: 20, 24, 25, 26, 27, 28, 29, 30, 33, 34, 35.
TWP 3, RGE 6E: 23, 24, 25, 26, 27.

3.3.2 Flood History

The farmer survey with respect to flood history was not totally satisfactory. Recent floods are most vivid in a person's memory and the details of earlier events tend to become forgotten.

The 1985 cropping season had low stream flows, yet the reported area flooded was considerably higher than previous years, as follows:

Cropland Affected

- acres -

	No Seeding	Delayed Seeding	Total
1985	335	195	530
1984	235	140	375
1983	160	195	355
1982	165	185	350
1981 and earlier	too few responses		

(1979 was reported as a particularly severe year)

In recent years, there has been an increase in clearing activity, leading to a higher proportion of the land area in crops that are prone to flooding damage.

When queried as to how often their lands were affected by overflows, most farmers indicated that their lands were affected seven to eight years out of ten by flooding. Some lands were affected by excessive wetness every year. A few fields had flooding less often, but still about five to six years out of ten.

3.3.3 Flood Damages

A) CROPLAND

In cases of being unable to seed cropland, the farmers would have a total loss of crop. The damages then become lost returns to land, idle capital in machinery and equipment, and wasted or idle labour. The farmer is also forced to summerfallow the land for the remainder of the season.

Where land is seeded late, the damages are primarily in the form of reduced yields due to the shortened growing season. Variable and fixed expenses would be essentially the same regardless of seeding date. Reported yield losses included the following, to illustrate the damages:

- wheat yields reduced by 15 bushels/acre.
- 40 bushels/acre oats instead of 60 bushels/acre on the rest of field.
- 50% yield reduction on all crops.

B) HAY AND PASTURE

Flooding destroys or reduces hay crops and shortens the grazing season on pasture up to two months.

With respect to tame forages, alfalfa stands cannot be established due to continual drownout of alfalfa. The use of other forage species subsequently results in lowered forage yields and quality. The farmers indicated that yield increases of up to two tons per acre could be achieved with alfalfa instead of native grasses, reed canary or timothy.

3.3.4 Farmer Attitudes to DU Project

In general, the farmers are quite positive about the DU project, contingent upon their flooding problems being resolved by supplementary works.

A) CROP DEPREDATION AND HUNTERS

Some concerns remain, however, especially the potential for increased crop depredation from waterfowl. Farmers already have problems from geese and crane depredation, and problems with hunters and off-road vehicles. Ruts on fields from 4-wheel drive trucks are a real issue. These problems are expected to become much worse with the DU project in place.

B) PROJECT BENEFITS

In addition to the direct control of Rat River flows on existing developed lands, the DU project and supplementary works would enable the following:

1. allow the planning and establishment of crop rotations.
2. better control of weeds.
3. longer growing and grazing seasons (considerable buckwheat and oats are grown at present due to shortness of season).
4. rationalization of fields and pastures resulting in:
   - squaring of fields and increased machine efficiency,
   - reduced fencing costs,
   - improved field access and subsequent cost reductions.
5. the establishment of better forages, especially alfalfa.
6. completion of development, including Crown land (clearing under CLIP has been completed on some quarters, but the farmers are reluctant to proceed further without flood protection, i.e. CLIP investments are not paying off).
7. initiate development on additional lands - for cropping, hay and pasture.

C) DYKE LOCATION

The farmers strongly suggested that the dyke to control Rat River overflows, between the easternmost cell of the DU project and the vicinity of the proposed main reservoir, should be constructed on the north side of Sections 19, 20 and 21 in Township 3, 7E.

The farmers and SPADA should be consulted before plans for any dykes/ditches or diversions are finalized.

4.0 PRELIMINARY ESTIMATE OF AGRICULTURAL BENEFITS

4.1 Cropland Damages

Cropland damages fall into two major categories, damages

from inability to crop the land and damages from delayed seeding.

Damages from inability to seed the crop are estimated as follows, using the Farm Planning Guide, 1986 Crop Estimates, as prepared by Farm Management Section, Manitoba Agriculture:

	$/acre
land investment costs	32.00
machinery investment	11.00
storage costs	2.85
labour and management	16.00
	$61.85
cost of summerfallow for remainder of season	25.00
TOTAL	$86.85

say $85.00/acre.

Damages from delayed seeding were assumed to be equivalent to 10 bushels/acre of wheat valued at $4.25/bushel (approximately $156/tonne) for a total of $42.50 per acre.

4.2 Cropland Area

Assume that the SPADA estimate of 1,500 cropland acres is a reasonable estimate of cropland affected by Rat River overflows. Assume further that these lands are affected approximately as shown in Table 2, for example, 1985 had 300 acres that could not be seeded and 1,200 acres that experienced seeding delays. The total damage for 1985 is subsequently estimated at 300 acres @ $85/acre plus 1,200 acres @ $42.50/acre = $68,000. Table 2 contains approximations of damages from 1985 to 1974.

The present value of these damages, assuming that they would continue into the future, is approximately $662,000, using a 5 per cent real discount rate. This is equivalent to a total annual average damage of about $74,700 in the affected area from lands used for annual cropping.

The monetary value of other damages was not estimated in this Report.

CONCLUSIONS AND RECOMMENDATIONS

The value of damages in the area affected by Rat River overflows which can be readily quantified on the basis of existing information and various assumptions is in the order of $662,000 when expressed in terms of present value. This means that considerable benefit could be realized from overflow control.

However, it must be realized that these monetary values are based on very limited hydrological information and a host of other assumptions. As such, one should not conclude that the Province, on behalf of the local farmers, should be obligated to bear the cost of works (agricultural or otherwise) up to a capital cost (including an allowance for future maintenenace of works) of $660,000, at which the agricultural benefit/cost ratio would be nearing unity.

The damage estimate should instead be interpreted to mean that substantial benefits are possible from works designed to reduce the agricultural excess water problems, that these works are quite likely to be economically feasible, that the Province should be prepared to negotiate with DU (Canada) on cost sharing, and that relevant government departments should be prepared to cooperate in the joint development of the wildlife and agricultural resources in the study area.

It is further recommended that the Department of Natural Resources conduct a detailed hydrological and flooded area study in the spring and early summer of 1986 in the study area to aid in confirming the affected lands that were assumed in this study.

TABLE 1

Maximum Daily Discharge of Rat River Near Sundown
(m^3/s*)

1960	36.5	on April 14**
1961	5.32	on April 22
1962	22.9	on May 24
1963	13.1	on April 10
1964	11.8	on April 19
1965	14.3	on May 8
1966	19.9	on July 5
1967	21.3	on April 22
1968	11.4	on June 12
1969	14.4	on April 14
1970	19.8	on May 31
1971	13.6	on April 13
1972	12.3	on April 19
1973	6.71	on June 22
1974	34.3	on April 22
1975	7.39	on May 2
1976	5.15	on April 19
1977	3.31	on September 29
1978	12.4	On April 19
1979	17.8	on April 20
1980	6.09	on April 9
1981	13.1	on September 9
1982	18.8	on April 16
1983	10.8	on May 15
1984	15.6	on June 11
1985	1.76	on March 26

*1 cubic metre/second (m^3/s) = 35.315 cubic feet/second (cfs).

**Extreme recorded for the period of record.

TABLE 2

Cropland Damage Estimates
1974 to 1985

	ACRES AFFECTED		TOTAL DAMAGE
	No Crop	Seeding Delay	
1985	300	1,200	$ 68,000
1984	1,000	500	106,250
1983	750	750	95,625
1982	750	750	95,625
1981	-	500	21,250
1980	-	500	21,250
1979	1,000	500	106,250
1978	750	750	95,625
1977	-	500	21,250
1976	-	1,000	42,500
1975	750	750	95,625
1974	1,500	-	127,500

"No crop" damage = $85/acre.
Seeding delay damage = $42.50/acre.

APPENDIX IV

Wild Fur benefits

Manitoba

Memorandum

Date October 5, 1988

To Tom Moran

From Cathy Johnson

OCT 7 1988

Subject Rat River Muskrats

Telephone 945-7763

2840 ha of regulated marsh
432 ha of fluctuating reservoir

The following calculations are based on the ideal situation with
1) 2 foot water fluctuations over 5 years
2) good seed bed and seed pool
3) 50-70% vegetation interspersion

Based on a fall population estimate of 1 muskrat house/.5 ha and 6 muskrats/house the population estimate would be 34,080. Then the fall harvest potential would be 32,712 at approximately $4 each= $125,416. If there is no harvest 70-80% of the population will be lost over the winter due to natural causes.

The spring population in both cases would be 2726 animals, assuming a 50:50 sex ratio then, 2726/2=1363 females will produce (2 litter of 7 young). 1363 X 14 = 19,082 young. Then the population the next fall would be approximately 2726 + 19,082 = 21,808 with a harvest potential of 17,447 @ $4 =$68,788. There is little natural mortality over the summer.

It may take 10+ years to reach the near ideal level and then it will be cyclic at about 5 year intervals depending upon water management and vegetation rejuvenation. Cycles will range from a 0 potential harvest to 32,000. The average for 5 years would be in the neighborhood of 6440.

When the population is high and vegetation is limited a large number of 'rats should be harvested in the fall to prevent winter eat outs and Tyzzer's disease. If a spring season was also instituted then, the overall population would be lowered depending upon the percentage of the breeding population removed, especially females.

The reservoir would be a bonus to the harvest in some years but on average this area would produce very few muskrats.

Hope this helps you out.

Cathy Johnson

Manitoba

Memorandum

Date December 30, 1986

To R. Robertson
Regional Wildlife Specialist
Bldg. 3, 139 Tuxedo Blvd.

From R. Ruhr
Senior Economist
Resource Allocation & Economics
Box 38, 1495 St. James St.

Telephone 945-3552

Subject VALUE OF RAT RIVER MUSKRAT PRODUCTION

First | Fold

Tom Moran has requested that I calculate the value of fur production for the Rat River project. Accordingly, I have discussed the project with Don Sexton of DU and with Dick Stardom . I have calculated a value of $824,000. That calculation represents the present value of the net income earned by trappers over the 30-year project period. The assumptions employed included the following:

1) A discount rate of 5%.

2) Trappers will have the motivation and experience to harvest the 20,000 rats which will be available from year 5 onward.

3) The pelt price used in the calculation was $5.05. The 10- and 15-year average real prices are $6.05 and $6.02 respectively, while the 5-year price is only $4.05. The 5-year price of course, reflects a very sharp decline in the real price after 1981. An examination of the history of real muskrat pelt prices as far back as 1971 indicates that, prior to 1982, the lowest price was $4.80. (That price occurred in 1981.) In all remaining years between 1971 and 1982, the real price was over $5.00 and it rose as high as $8.99 in 1980. In view of the price history, I felt that the 5-year price was somewhat low. However, in view of the low real prices of recent years ($3.15 - $3.40) the 10-year and 15-year average prices of around $6.00, appear to be too high. Therefore, I decided to average the 10-year and the 5-year average prices. That is how I derived a pelt price of $5.05.

Since I have not had the opportunity to review the methodologies employed in the derivation of the other resource values, I would recommend that the $824,000 fur value be regarded as tentative for the time being.

R. RUHR

RR/em

c.c. W. Fisher
J. Potton

ADJUSTED DOWNWARD BASED ON REVISED FEASIBILITY STUDY

APPENDIX V

Recreational Hunting Values

Recreational Hunting Values

Factors

- Size of Rat River Project area.....5,300 ha
- Minimal agriculture land in cereal crop production
- Present waterfowl harvest--ducks - low
  geese - low
- Number of recreational hunters has decreased in last five years -D.U. estimate of 450,000 bird days of use may be optimistic
- Rat River project area lies within migrational route of some duck populations but primarily giant Canada Geese and EPP Canada Geese.

Assumptions

- If sufficient agricultural fields are available in the area ducks(mallards) and Canada Geese may use the area as a staging marsh during fall migration. In order to hold these birds it would be necessary to create a waterfowl refuge on a portion of the project area.
- If waterfowl respond in large numbers, crop damage will be inevitable.
- If waterfowl respond by staging in large numbers, it is safe to assume that non-resident hunters would be attracted to the area. Minnesota hunters would probably make return trips to the area within the same hunting season.
- The distance from the City of Winnipeg (110 Km) may predude many hunters from visiting the area due to the much shorter distances to Oak Hammock Marsh Netley Marsh, Grants Lake and Shoal Lake.

Hunter use estimate comparison

	Bird days use	Hunter trips
Oak Hammock	3,000,000	8,000(Known)
Grants Lake	750,000	2,250(Known)
Rat River	450,000	600

- Estimate potential hunters to be 300 to 400
  - Number of trips 300 x 1.5 = 450
    400 x 1.5 = 600

- Estimate between 300 and 400 hunters could make between 450 to 600 trips based on a staging population of approximately 20% of that occurring at Oak Hammock Marsh. The hunting populous would be composed primarily of non-resident hunters.
- If lure crops were available and a buffer zone or no hunting area were included, larger numbers may occur and consequently more hunters could use the area.
- Recreational hunting values are calculated as follows:

  Resident hunter days: 125 x $30.72 = $3840.00/yr

  Non-resident hunter days : 400 x $14.30 = $5720.00/yr

  Total = $9560.00/yr

  ==========

- Value to the Province from recreational hunting would be approximately $99,600.00 over a 30 year period and $124,000.00 over a 50 year period.

MAPS
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CARTES
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